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Quantitative Comparison of Science and Engineering Doctorates in Japan and The United States

—Training of Researchers in Japanese Doctorate Programs—

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Synopsis

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In order to pursue more advanced research and development in the future, Japan will have to secure outstanding human resources in science and technology. Science and technology, in particular, will become more and more sophisticated throughout the world, and persons holding doctorate degrees will be able to obtain numerous opportunities to take part in international cooperative research activities. In view of these and other developments, the roles played by holders of doctorate degrees will take on increasing importance in the pursuit of research and development in the future.

From this perspective, our investigative survey focussed on doctorate courses in natural sciences (science and engineering) provided by graduate schools in Japan and investigated various conditions, including admission of doctorate candidates to graduate schools, acquisition of doctorate degrees and the course of activities after doctorate holders have completed their training programs. A comparison was thus made between the number of doctorates produced in Japan per year with the number produced in the United States, and an analysis was made, from a quantitative standpoint, of the functions played by the training program for science doctorates at graduate schools in Japan as an institution for cultivating researchers.

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In order to make a comparison between the number of doctorates produced each year in Japan and in the United States, the following steps were taken.

(1) The number of science and engineering doctorates out of a total population of 100,000 (hereinafter referred to as "number of doctorates per unit population") was used as a yardstick.

(2) The fields of specialization among doctorates in the United States which correspond to those of science and engineering doctorates in Japan were organized.

(3) Of the doctorates by dissertation in Japan (hereinafter called "dissertation doctorates") a breakdown was made between those equivalent in terms of age to the doctorates by training course (hereinafter called "course-work doctorate") and those not equivalent.

(4) A distinction was made between cases in which foreign students are included and cases in which they are not included.

In order to make the breakdown referred to in (3) above, the history of the doctorate by dissertation system was investigated and all types of data resources were gathered and summarized. Of

the total number of doctorates, the percentage of course-work doctorates stood at 55% among science doctorates and at 40% among engineering doctorates. The average age of course-work doctorate acquisition was 29 years for course doctorates, and among dissertation doctorates, 40 years for science doctorates and 42 years for engineering doctorates. In order to make the distinction in item (4) above, the number of foreign students studying under the doctorate program was investigated, and it was determined that both in Japan and the United States the number of foreign students has been increasing, with this increase most conspicuous among engineering doctoral candidates.

In comparing the number of doctorates in Japan and the United States, the number of doctorates in Japan taken up as the subject of comparison was divided into three categories:

(1) Number of course-work doctorates;

(2) Total number of both course-work doctorates and dissertation doctorates;

(3) Total of the number of course-work doctorates and the number of dissertation doctorates 35 years of age or younger (number of young doctorates).

The number of doctorates under each of these categories was compared with the number of doctorates in the United States. Moreover, in the comparison of the number of young doctorates in Japan (3) with the number of doctorates in the United States, this survey is unique in that it considers both cases in which foreign students are included and cases in which they are excluded.

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Results of the aforementioned survey disclosed the following distinguishing characteristics about those who obtain science and engineering doctorate degrees in Japan.

(1) The number of science doctorates produced annually in Japan is overwhelmingly small in comparison to the United States.

For cases excluding foreign students, the number of course-work doctorates per unit population appearing annually from the science doctorate program of graduate schools in Japan is only one-seventh the number in the United States.

For cases excluding foreign students, the number of young science doctorates per unit population (total of course-work doctorates and dissertation doctorates 35 years of age or younger) is no more than one-sixth the number in the United States.

Moreover, in recent years the percentage of candidates who progress from the graduate school initial doctorate program (first 2 years) and master's program (in this report hereinafter, these two categories will be included under "master's program") to the final graduate school doctorate program (last 3 years) has been declining.

(2) The number of young engineering doctorates produced in Japan is smaller than the number in the United States and in recent years, the gap between these numbers has been widening.

For cases excluding foreign students, the number of course-work doctorates per unit population appearing annually from the engineering doctorate program of graduate schools in Japan is equal to two-fifths the number in the United States. In recent years, Japan has seen a conspicuous increase in the number of foreign students in its engineering doctorate programs, and since these foreign students account for the overall increase in the number of students enrolled in these programs, the number of course-work doctorates per unit population has actually been declining.

The average age of those who receive a doctorate degree by dissertation writing has been rising to reach 42 years. For cases excluding foreign students, the number of young engineering doctorates (total of course-work doctorates and dissertation doctorates 35years of age or younger) per unit populatio is one half the number in the United States. And over the past seven years, the gap between the two numbers has been widening.

(3) In order to broaden the scope of science and technology in Japan and increase the level of sophistication of the same, there must be an increase in the number of young doctorates who possess an abundance of knowledge in diverse fields of specialization, encompassing both science and engineering. A high percentage of science doctorates depend upon the graduate school doctorate program for their training and among engineering doctorates, although the majority are dissertation doctorates, the age at which these candidates obtained their doctorate degrees by dissertation is rising. We must assume, therefore, that in order to increase the number of young doctorates in both of these categories, the graduate school doctorate program will become more and more important in the future for cultivating researchers.

Foreword

Japan will have to secure outstanding human resources in science and technology inorder to promote greater research and development in the future.

Henceforth, science and technology will assume a more advanced level throughout the world, and those who hold doctorate degrees will find numerous opportunities for active participation in international research activities. In view of these and other development, the role played by holders of doctorate degrees in promoting researchand development has become extremely important.

From this perspective, the present investigative study took up science doctorates and engineering doctorates in the domain of natural science and investigated and analyzed the number of science doctorates and the number of engineering doctorates produced by the graduate school doctorate programs for science and engineering in Japan and the numbers of the same doctorates produced by the dissertation doctoral system. A comparison was then made of the numbers of science and engineering doctorates in the United States, and the results were used to help clarify the issues confronting Japan with respect to human resources in the realm of science and technology.

A quantitative comparison was made by considering the number of doctorates in a total population of 100,000 (number of doctoratesper unit population).

This report presents a summary of the authors' opinions based on the results of investigation and analysis of research data, including various surveys by the Ministry of Education, Science and Culture, by the Ministry of Labor and by the Science and Technology Agency, on subjects such as the status of enrollment in graduate school doctorate programs for science and engineering doctorates in Japan, those the increase in the number of foreign students in Japan, the number of those who completed Science doctorate programs and received this degrees and those who did not. (Here, "those students who have studied under the doctorate programs for longer than the prescribed time limit, students who have obtained all the prescribed credits but who have been graduated without taking an academic degree." The same applies hereinafter.), the number of course-work doctorates produced annually, the history of the so called dissertation doctoral system, the number of dissertation doctorates produced annuyally as well as the number of young dissertation doctorates not more than 35 years old.

The status of graduate schools and doctorates in the United States was abstracted from reports by the National Science Foundation of the United States. These references are listed in attachment VI at the end of this report.

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I Organization of Assumed Conditions for Making Comparisons

1 Standards of Comparison and Specialized Fields Subject to Comparison

(1) Standards of Comparison

Used as a yardstick for comparison of the number of doctorates were the number of science doctorates and the number of engineering doctorates obtained by dividing the total number of doctorates produced each year by a total population of 100,000 people. (Herein after this is referred to as the number of doctorates per unit population.)

The periods for comparison of number of doctorates were as follows. For Japan, the number of doctorates was broken down by fiscal year; it covers those who obtained the doctorate degree between March of the previous year and April of the current year. For the United States, the number who obtained the doctorate degree between May of the previous year and June of the current was taken as the number of doctorates.

Accordingly, a comparison was drawn between the number of doctorates per unit population in year X for the United States and year X-1 for Japan. In the case of Japan, the number written in parenthesis denotes the fiscal year.

There are two types of students at graduate schools in the United States: full-time students and part-time students. Hence the percentage of academic advancement was calculated for the case of both types and for the case of only full-time students.

Incidentally, in 1980 and 1985, the percentage of part-time students among all students who continued study after obtaining the master's degree was slightly more than 20 percent among science doctorate candidates; and among engineering candidates, the rate dropped from 44 to 32 percent.

(2) Specialized Fields Subject to Comparison

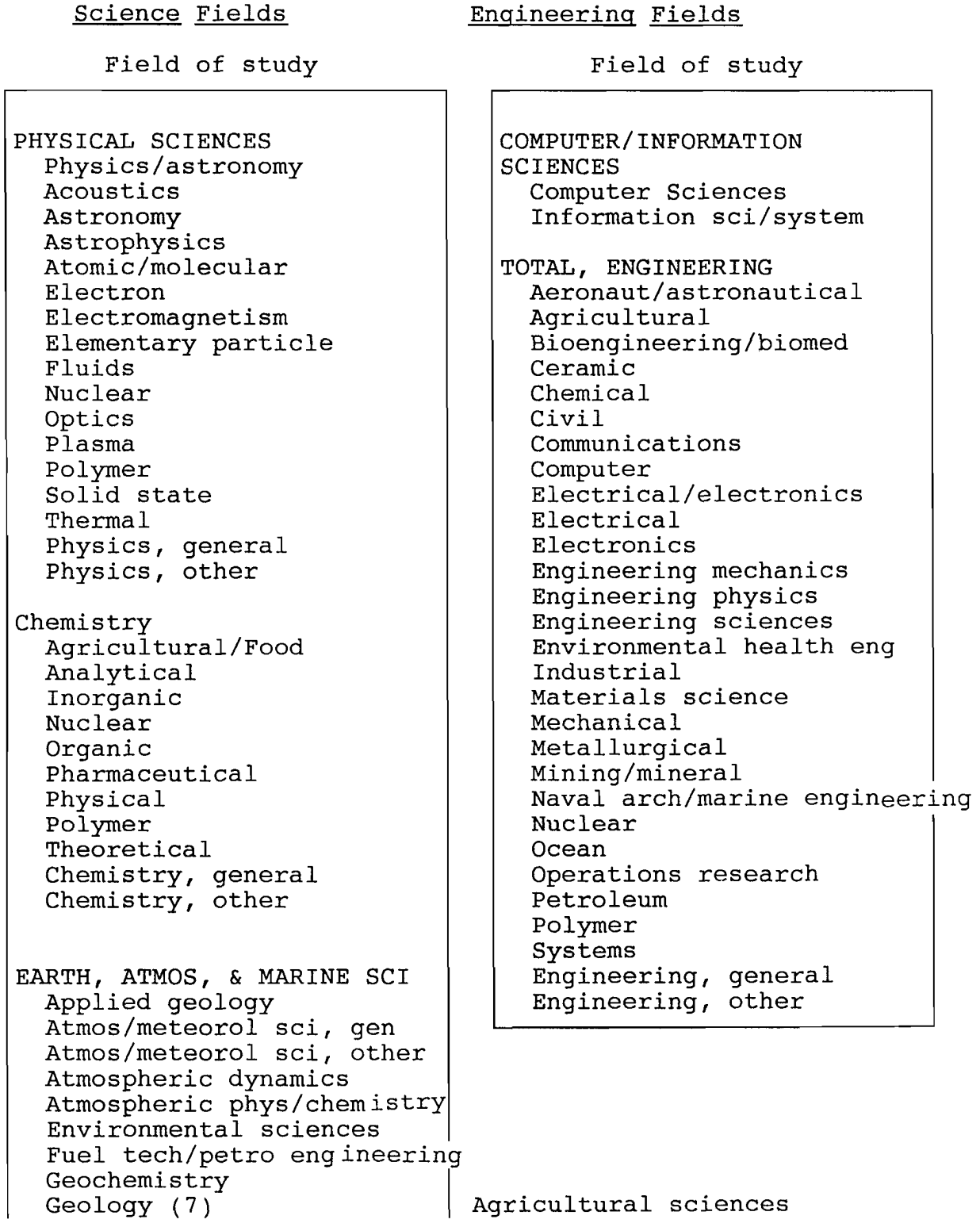
For the sake of comparison, the major fields of study pursued by doctorate candidates in the United States were organized as shown below to correspond with science doctorates and engineering doctorates in Japan.

Science fields in the United States: physical sciences (physics, astronomy, chemistry etc.), mathematics/statistics, environmental sciences, biological sciences Engineering fields in the United States: engineering, computer sciences

Presented below is a detailed list of the various fields of

specialization included under the science and the engineering categories, respectively, in the United States.

Figure 1. Breakdown of Major Fields in the United States into Science and Engineering Categories



- Structural geology
- Geomorph/glacial geology
- Geophysics/seismology
- Hydrology/water research
- Marine sciences
- Marine sciences, other
- Meteorology
- Minerology, petrology
- Oceanography
- paleontology
- Stratigraphy, sediment
- Geological sciences, general
- Geological sciences, other
- Earth sciences, general
- Earth sciences, other
- Physical sciences, other

MATHEMATICS
- Algebra
- Analysis/funct analysis
- Applied mathematics
- Computing theory
- Geometry
- Logic
- Number theory
- Operations research
- Probability/math statistics
- Topology
- Mathematics, general
- Mathematics, other

Biological sciences
- Anatomy
- Biochemistry
- Biometrics/biostat
- Biophysics
- Botany, other
- Botany
- Cell biology
- Cytology
- Ecology
- Embryology
- Entomology
- Human/animal genetics
- Plant genetics
  - Genetics
  - Human/animal pathology
  - Plant pathology
  - Pathology
  - Human/animal pharmacol
  - Human/animal physiol
  - Animal physiology
  - Plant physiology
  - Hydrobiology
  - Immunology
- Agronomy
- Animal breeding/genetics
- Animal nutrition
- Animal sci/nutrition
- Dairy science
- Poultry science
- Animal science, other
- Fish/wildlife
- Fisheries Science
- Wildlife management
- Wildlife/range management
- Food sciences
- Food engineering
- Food sciences, other
- Forestry sciences
- Forest biology
- Forest engineering
- Forest management
- Wood sciences
- Renewable natrl resrces
- Forestry&related sci,other
- Horticulture science
- Plant breeding/genetics
- Plant pathology
- Plant protectn-pest management
- Phytopathology
- Plant sciences, other
- Soil sciences
- Soil chem/microbio
- Soil sciences, other
- Agriculture, general
- Agriculture, other

SOCIAL SCIENCES
- Agricultural economics
- Anthropology
- Archeology
- Demography
- Econometrics
- Economics
- Geography
- History of science
- Linguistics
- Pol sci/government
- Political science
- Sociology
- Statistics

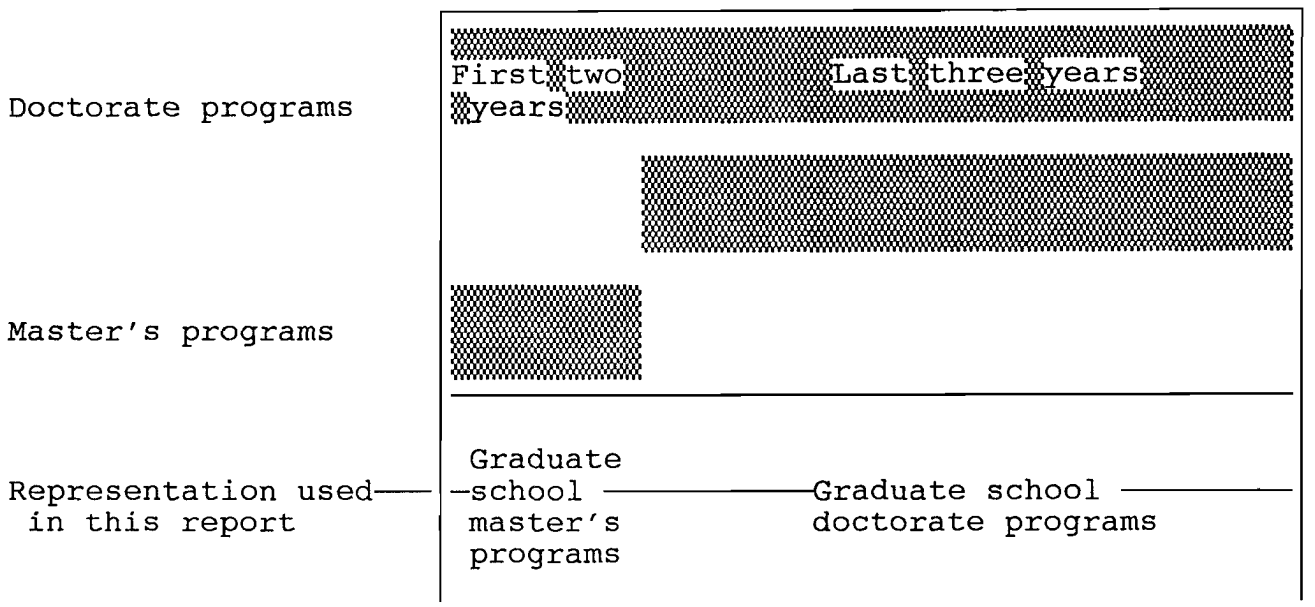
PSYCHOLOGY
- Clinical
- Cognitive
- Counseling
- Developmental
- Educational

Microbiology	Experimental
Bacteriology	Indust/organizational
Microbiology/bacteriol	
Molecular biology	Physiological
Neurosciences	Quantitative
Nutritional Sciences	Personality
Parasitology	Psychometrics
Toxicology	School
Zoology, other	Social
Zoology	Psychology, general
Biological sci, general	Psychology, other
Biological sci, other	

2 Programs at Graduate Schools in Japan

The programs for doctorate and for master's degree candidates at graduate schools in Japan are depicted in Figure 2 below. In this report, however, for the sake of convenience, the representation given in the lowest row of the figure is used.

Figure 2. Doctorate Programs and Master's Programs at Graduate Schools in Japan



3 Conditions for Granting the Doctorate Degree in Japan

Grant of the doctorate degree in Japan is governed by Article 3 of the Regulations on Academic Degrees (Ministry of Education ,Science and Culture Ordinance No. 9 of April 1, 1953; revised on September 1, 1989) which reads as follows: With respect to major field, the candidate must possess an advanced level of research competence and an abundance of academic knowledge serving as a basis for the same as necessary for carrying out research activities independently in the field and/or performing other specialist duties of an advanced nature.

Note: The clause which in 1953 read as, "Candidates who pioneer new fields through independent research and/or who contribute to the advancement of culture by elevating the level of academic learning while also possessing competence to serve as leaders of research in the respective field of academic specialization," was revised from 1974 to August 31, 1989 to read as follows: "Candidates who possess a high level of competence in research as required

for carrying out research activities independently in the field of specialization and who possess abundance of academic knowledge to serve as a basis for the same."

Two stipulations govern the conditions under which the doctorate degree is granted. The first is the stipulation, contained in Article 5, Section 1 of the Regulation on Academic Degrees, which requires that the candidate be one who has completed the doctorate program at a graduate school whose purpose (Article 4 of Standards for the Establishment of Graduate Schools, as of September 1989) is to cultivate a high level of competence in research and an abundance of academic knowledge for the same as necessary for carrying out research activities independently in the field of specialization and/or performing other specialized duties of an advanced nature.

The second stipulation, contained in Section 2 of the same Article, admits that the doctorate degree can also be granted to candidates who have submitted a dissertation paper which was accepted upon examination by the graduate school as stipulated by the university and who have been recognized as having academic competence equivalent to or greater than that of candidates who have completed the doctorate program of the graduate school. (Hereinafter, those candidates who have been granted the doctorate degree under the terms of this stipulation are referred to as "dissertation doctorates.")

The terms of Section 2 apply to the dissertation doctorate system, which is unique to Japan and not existing in the United States.

4 History and Present Status of Dissertation Doctorate System

(1) History of Dissertation Doctorate System

— Dissertation doctorate system has fulfilled its functions in accordance with actual conditions of the era —

The doctorate degree system was defined in Japan in 1887 as follows according to Article 3 of the Academic Degree Ordinance of 1887 (Executive Ordinance No. 13 of May 20, 1887):

1) The doctorate degree shall be granted by the Ministry of Education, Science and Culture to those candidates who have entered a graduate school and passed the prescribed examinations.
2) Or, the doctorate degree shall be granted to those candidates who have scholastic competence equivalent to or greater than that of the above candidates as determined by deliberation of the Teikoku University Evaluation Committee.

The second stipulation applies for those who were the equivalent of the dissertation doctorates of the present.

No documents can be found which clarify the objectives behind the compilation of stipulations for the dissertation doctorate.

Yet the problem encountered upon actually granting the doctorate degree based on the provisions of the Academic Degree Ordinance was the fact the in the "Record of Doctorates in Japan" (reference document 1), the following statement was written because the National University Graduate School had just been establish a year earlier. "There were no candidates who entered the graduate school and passed the prescribed examination as described in the relevant section." In view of this fact, it can be inferred that the dissertation doctorate system had the coloring of an interim measure as well as a newly stipulated doctorate degree system.

The first candidates in Japan to receive the doctorate degree were selected in May 1888 on the basis of stipulation 2 above after having gone through various complications. There was one candidate each from the fields of law, medicine, engineering, literature and science, for a total of five doctorates. They were described as being" ....introduced to the world as distinguished scholars of the time, included with 11 professors at Teikoku University." (See re ference document 1.)

This means that the first doctorates in Japan where scholars who correspond to the dissertation doctorates of today.

Incidentally, according to the Record of Doctorates in Japan (reference document 1), all of the 32 science doctorates and 31 ngineering doctorates over the ten-year period from 1887 received their degrees by recommendation of the Teikoku University EvaluationCommittee based on the provisions for the latter category of doctorates. (For more details, refer to Table No. 2 among the attached statistics tables.)

Thereafter, the dissertation doctorate system was clearly defined in Article 2, Section 1 of the Academic Degree Ordinance of 1898 (Executive Ordinance No. 344 of December 9, 1898) as applicable for "Candidates who have submitted a dissertation paper and requested a doctorate degree and who have been recognized as having scholastic competence equal to or greater than that of other doctorate candidates."

As a result of granting academic degrees under these provisions, it was reported that the majority of recipients of the doctorate degree between 1907 and 1911 had obtained it by submitting a dissertation (Taken from reference document 1.)

Looking at the roster of doctorates listed in reference document1, when the number of recipients of academic degrees is broken down and totaled by Article and Section, it becomes clear that of the 27 science doctorates awarded between 1907 and 1911, the number who can be clearly regarded as dissertation doctorates amounts to 15 people. (For details, refer to Table 2 among the attached statistics tables.)

With the end of the Second World War in 1945, the educational system in Japan underwent a drastic reformation.

In examining the academic degree system based on the new systemof graduate schools, the Civilian Information and Education Section of the General Headquarters of the Supreme Commander for the Allied Powers directed to the No. 8 Special Committee of the Deliberation Council on University Establishment that the dissertation doctorate system be abolished.

In response, the Council on University Establishment made

the following declaration:

"There are researchers who, in spite of their superior ability in Learning cannot study at universities for financial and other rea sons, accordingly cannot attend the graduate schools of universities,but acquired the general and professional knowledge equal to or more than that of general and professional knowledge equal to or more than of those who have completed the doctor's course in the graduate school... It is also the undeniable fact that those people have been making distinguished contribution to the development of science in this country "

(Quoted from "Concerning the system of conferring doctorate for the thesis submitted (draft)," part of the literature of the National Education Research Center designated in reference document 3-1.)

It advocated that the dissertation doctorate system is "It is considered specially necessary in a country like Japan ..... , and to provide for the progress and development of learning " in Japan. "In recognition of this fact " (from reference document 5), Article 5, Section 2 of the Academic Degree Regulations of 1953 (Ministry of Education, Science and Culture Ordinance No. 9 of April 1953) defines the dissertation doctor system as follows: "The doctorate degree can be awarded to candidates who have submitted a doctorate dissertation which has been examined and accepted by a graduate school and who have been recognized as having the equivalent or greater academic competence than do those referred to in the previous Section." The dissertation doctorate system, as thus defined, has remained in Japan up to the present.

(2) Present Status of Dissertation Doctoral System

-- Less than half are science doctorates and more than half are engineering doctorates --

The numbers of science doctorates and engineering doctorates awarded on the basis of the Academic Degree Regulations of 1953 are indicated in Table 1 below.

Of the total of doctorate degrees granted over a one-year term in fiscal 1957, 47 candidates received science doctorates and 25 candidates received engineering doctorates; all of these candidates completed the doctorate program.

Thereafter, the percentage of dissertation doctorates in the total number of doctorates reached 1 percent among science doctorates in fiscal 1958, 3 percent in the following year, then climbed to 25 percent in fiscal 1961, and up to 50 percent in fiscal 1962. The figure dropped below 50 percent from 1973 onward and stood at 45 percent in fiscal 1987.

The percentage of dissertation doctorates among engineering

doctorates increased rapidly from 8 percent in fiscal 1960 to 55 percent in fiscal 1963. Thereafter, except for a brief two-year period, the percentage continued to exceed 50 percent, then surpassed 60 percent from fiscal 1982 and returned to 60 percent in fiscal 1987.

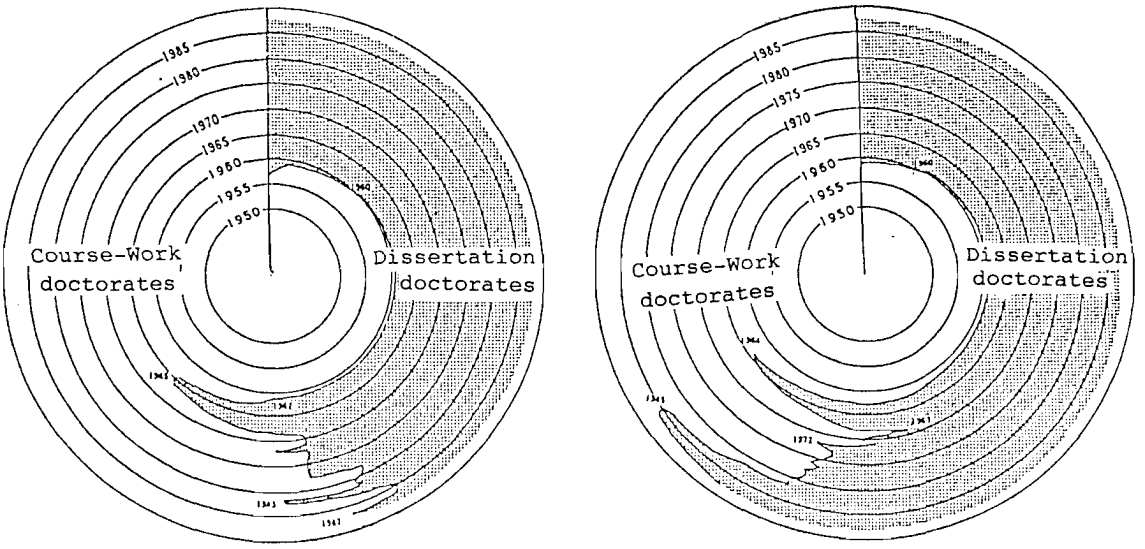
Table 1 Trend in Numbers of Course-Work Doctorates and Dissertation Doctorates

Fiscal year	Science doctorates				Engineering doctorates			
	Course A	Dissertation B	Total C	Percentage b/c*100	Course A	Dissertation B	Total C	Percentage b/c*100
1957	47	0	47	0	25	0	25	0
1960	139	23	162	14	72	6	78	8
1961	173	59	232	25	69	17	86	20
1962	137	138	275	50	84	54	138	39
1965	159	257	416	62	156	263	419	63
1970	323	287	610	47	425	428	853	50
1975	354	322	676	48	456	530	986	54
1980	457	365	822	44	523	663	1186	56
1985	497	363	860	42	480	924	1404	66
1986	479	341	820	42	505	988	1493	66
1987	464	373	837	45	621	926	1547	60

Source: Compiled by author from "University Data Resources" (each issue, reference document 10 to 33) of the Ministry of Education, science and culture Editor.

Note: Percentage refers to the percentage of dissertation doctorates in the total number of doctorates. For details broken down by national university, public university and private university, refer to Table 3 and Table 7 in the attached statistics tables.

Figure 3 Trend in Percentages of Course-Work Doctorates and Dissertation doctorates



Science Engineering

As indicated in Figure 3, the percentage of dissertation doctorates among science doctorates peaked in fiscal 1965 and among engineering doctorates, it peaked in fiscal 1964. This unique pattern corresponds to the periods in which the science and engineering departments were being expanded and reinforced. It is especially noteworthy in considering the role which the dissertation doctorate system has played up to the present.

At present, the majority of science doctorates are course-work doctorates while the majority of engineering doctorates are dissertation doctorates. This indicates that whereas the majority of science doctorates depend upon the doctorate program of a graduate school, the majority of engineering doctorates depend upon some other research institution, rather than the graduate school program.

This unique characteristic is especially important to bear in mind when comparing the award of doctorate degrees in the United States and in Japan.

(3) Average Age of Course-Work Doctorates Earners and Average Age of Dissertation Doctorates Earners

— No change for course-work doctorates but rise in average age for dissertation doctorates —

An investigation was made of the average age at which course-work doctorates received their degree and the average age at which dissertation doctorates received their degree in Japan, and a comparison was made with the average age of doctorate

acquisition in the United States.

1) Age of Doctorate Earners in Japan

— Average age for course-work doctorates is 29 years and the average for dissertation doctorates is 40 years for science and 42 years for engineering degrees —

No data sources can be found which clarify the average age at which candidates obtain the doctorate degree in Japan. Hence an attempt was made to gather data from which the age at the time of doctorate acquisition can be calculated, and as a result, the Record of Doctorates in Japan (reference documents 1, 2, 4, 5) and the materials of the National Diet Library for fiscal 1988 were obtained.

The day, month and year of birth of all doctorate degree recipients at all universities of the nation are recorded in the Record of Doctorates in Japan, but in the materials of the National Diet Library for fiscal 1988, the day, month and year of birth is recorded only for three universities: Tohoku University, Kyoto University and Kyushu University. Of necessity, University of Tokyo was added to these three universities, and the ages upon acquisition of the science doctorate and the engineering doctorate were calculated based on the foregoing data resources for FY 1960, FY 1965, FY 1970 and FY 1988 (University of Tokyo not included in FY 1988). The time series change over this period was examined.

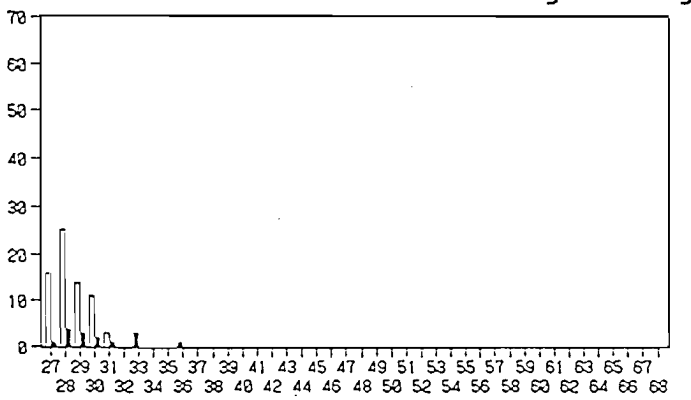
Table 2 Average Age of New Science Doctorate (Course-Work Doctorate)

Fiscal year	Tohoku U.	Kyoto U.	Kyushu U.	Tokyo U.	Total
1960	29.3	29.2	28.4	28.6	28.8
1965	28.3	30.5	29.0	28.8	29.0
1970	28.2	29.4	29.6	28.8	28.8
1988	28.1	29.6	29.3		29.1

Table 3 Average Age of New Science Doctorate (Dissertation Doctorate)

Fiscal year	Tohoku U.	Kyoto U.	Kyushu U.	Tokyo U.	Total
1960	28.9	28.0	29.5	28.8	
1965	37.6	37.8	34.0	35.0	36.7
1970	38.2	37.1	36.4	33.6	36.1
1988	40.9	39.7	36.8		39.5

Figure 4 Age Distribution of New Science Doctorates (according to current academic degree regulations) in FY 1960



Scale: denotes course-work doctorates
denotes dissertation doctorates

In each of the figures, the vertical axis numbers denote population and the horizontal axis numbers denote age.

Figure 5 Age Distribution of New Science Doctorates in FY 1965

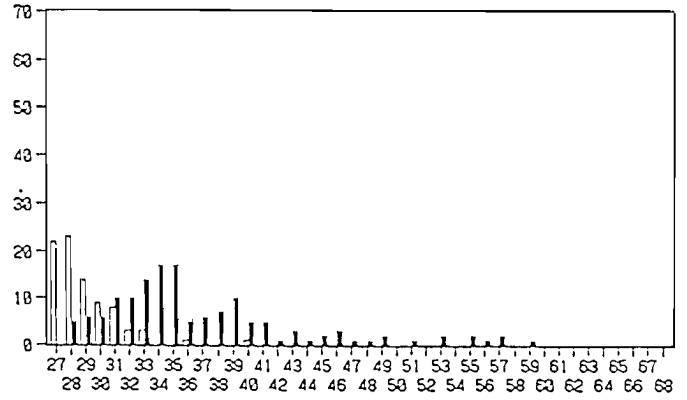


Figure 6 Age Distribution of New Science Doctorates in FY 1970

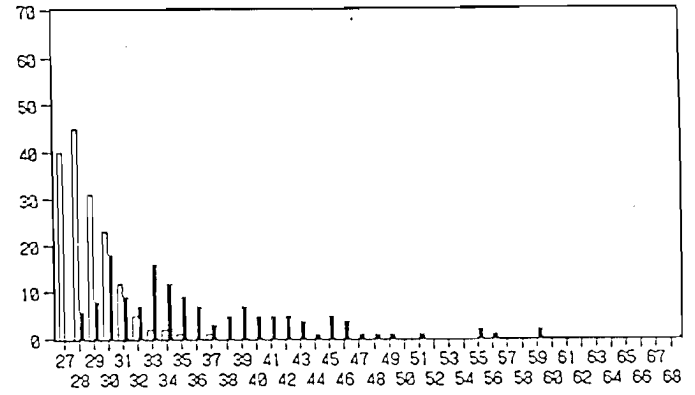
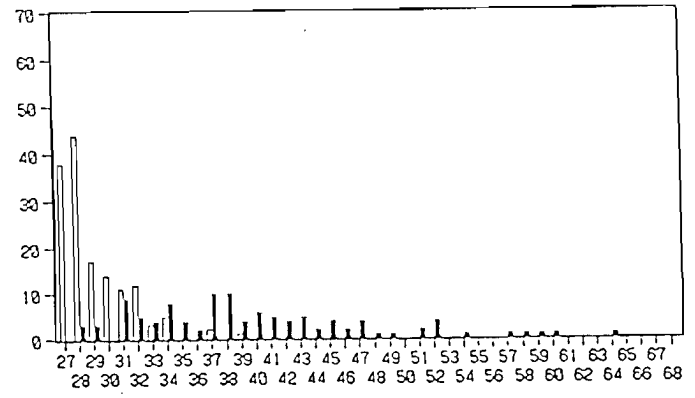


Figure 7 Age Distribution of New Science Doctorates in FY 1988



As a result, it became clear that the average age of science doctorate acquisition in FY 1988 was 29 years for course-work doctorates and 40 years for dissertation doctorates.

The trend in age upon acquisition of the science doctorate is as depicted in Figures 4 to 7.

The average age of engineering doctorate acquisition in FY 1988 was 29 years for course-work doctorates and 42 years for dissertation doctorates.

Table 4 Average Age of New Engineering Doctorate Degree (Course-Work Doctorate)

FY	Tohoku U.	Kyoto U.	Kyushu U.	Tokyo U.	Total
1960	28.9	28.9	30.0	29.0	29.0
1965	29.2	30.5	33.0	28.4	29.2
1970	28.7	29.7	30.5	28.4	28.9
1988	28.3	29.1	28.1		28.5

Table 5 Average Age of New Engineering Doctorate Degree (Dissertation Doctorate)

FY	Tohoku U.	Kyoto U.	Kyushu U.	Tokyo U.	Total
1960		30.7		37.0	32.3
1965	37.4	37.6	37.3	40.0	38.7
1970	38.4	37.3	39.3	41.5	39.5
1988	43.2	40.7	42.1		41.9

The trend in age upon acquisition of the engineering doctorate is as depicted in Figures 8 to 11.

Looking exclusively at the calculations made for the four universities, we note that among dissertation doctorates the average age of acquisition of either the science or engineering doctorate increased gradually. Of the total number of dissertation doctorates, the percentage who received their degrees at 35 years of age or younger dropped sharply each year.

The average age upon acquisition of the dissertation doctorate is slightly higher among engineering doctorates than among

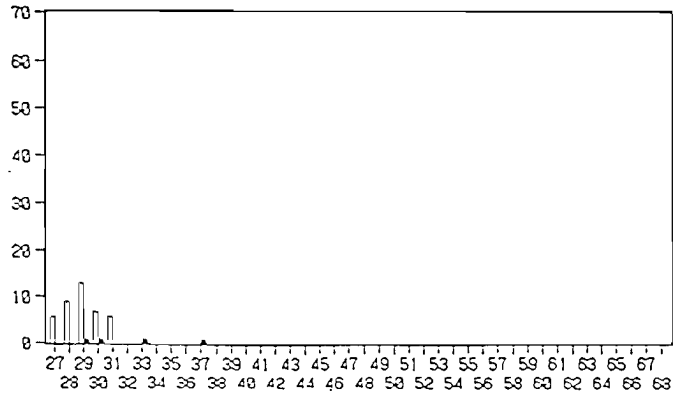
science doctorates. (For details, refer to Tables 11 to 18 of the attached statistics tables.)

Figures 5, 6, 9 and 10 reveal that the majority of dissertation doctorates tend to receive their degrees between the ages of 51 and 55 years.

The reasons for this trend are conjectured as follows. Figures 5 and 9 cover FY 1965 and those who were 51 years of age at that time were born in 1915. Figures 6 and 10 cover FY 1970 and those who were 55 years of age at that time were born in 1916.

Those who were born in 1916 reached 24 years of age (youngest age for completion of master's degree program) in 1938. We can infer that many students at that time could not go on with course work on a doctorate program at a graduate school because of the impact of the Second World War.

Figure 8. Age Distribution of New Engineering Doctorates (according to current academic degree regulations) in FY 1960



Scale: denotes course-work doctorates
denotes dissertation doctorates

In each of the figures, the vertical axis numbers denote population and the horizontal axis numbers denote age.

Figure 9. Age Distribution of New Engineering Doctorates in FY 1965

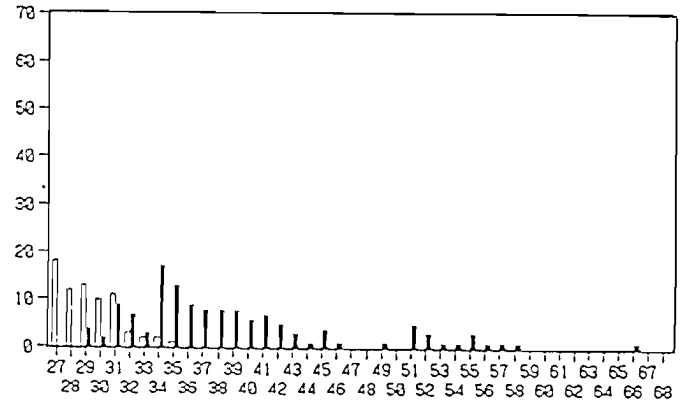


Figure 10. Age Distribution of New Engineering Doctorates in FY 1970

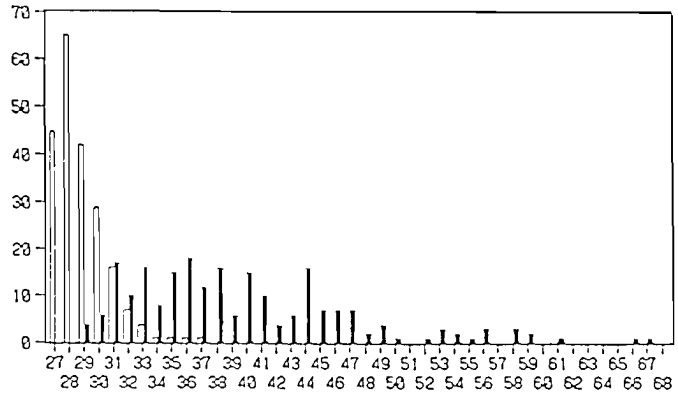
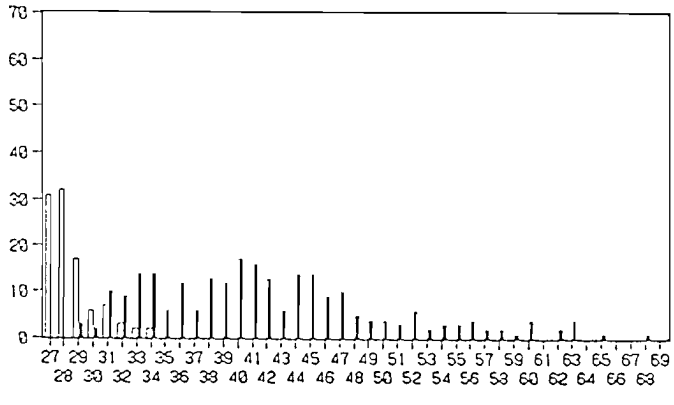


Figure 11. Age Distribution of New Engineering Doctorates in FY 1988



Viewed in this light, it becomes evident that the dissertation doctorate system provides a second opportunity to try to obtain the doctorate degree to those who have lost the chance to obtain a degree previously due to social or personal factors at the time.

In examining the history of the dissertation doctorate system, it is noteworthy to consider the increases in the number of doctorate recipients in 1964 and 1965.

2) Age of Doctorate Earners in the United States

— Median value is around 30 years of age —

The median values for the age at which the doctorate degree is acquired in the United States are shown in Table 6. A gradual upward trend in age can be noted but in the 1980s the age hovered at around 30 years.

Table 6 Median Values for Age of New Science and Engineering Doctorates in the United States

	1970	1980	1985	1986	1987
Total sciences	29.0	30.2	31.2	31.4	31.5
Total engineering	29.6	30.3	30.9	31.0	31.0

Source: NSF "science and engineering doctorates: 1960*87"
Note: Social sciences and computer/information sciences are included in total sciences; computer/information sciences are not included in total engineering. For details, refer to Table 19 of attached statistics tables.

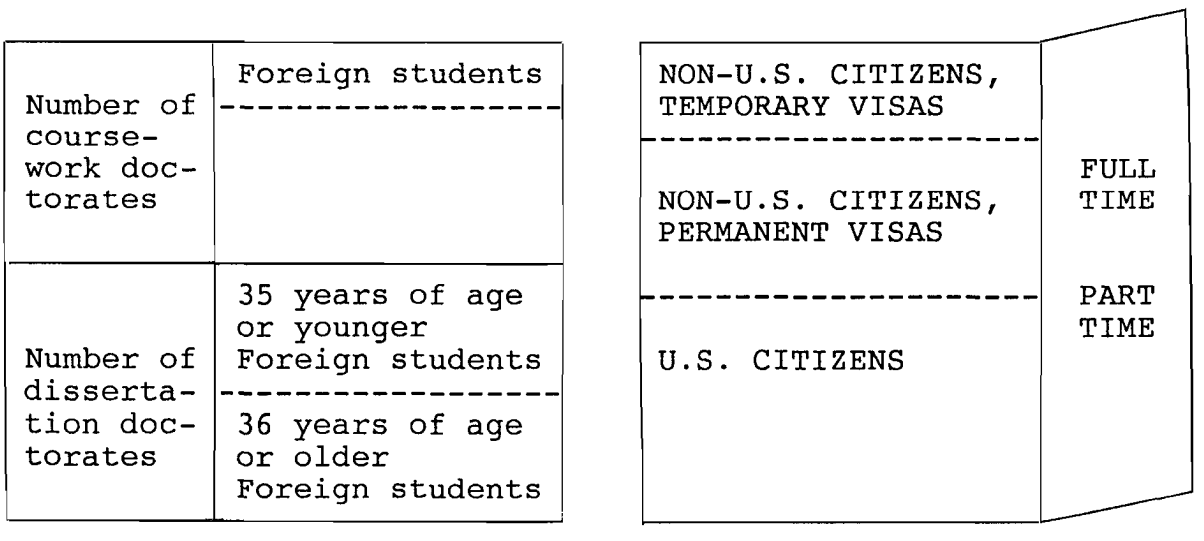
5 Doctorate System Structures and Types of Comparisons by Number of Doctorates

(1) Index of Comparison by Number of Doctorates and Structures of Doctorate Systems in Japan and the U.S.

In this survey, the number of doctorates produced per year against a total population of 100,000 was used as an index for-comparing numbers of doctorates.

The structures of the doctor systems in Japan and the Unit-edStates and the configuration of students in the United States are shown in Figure 12.

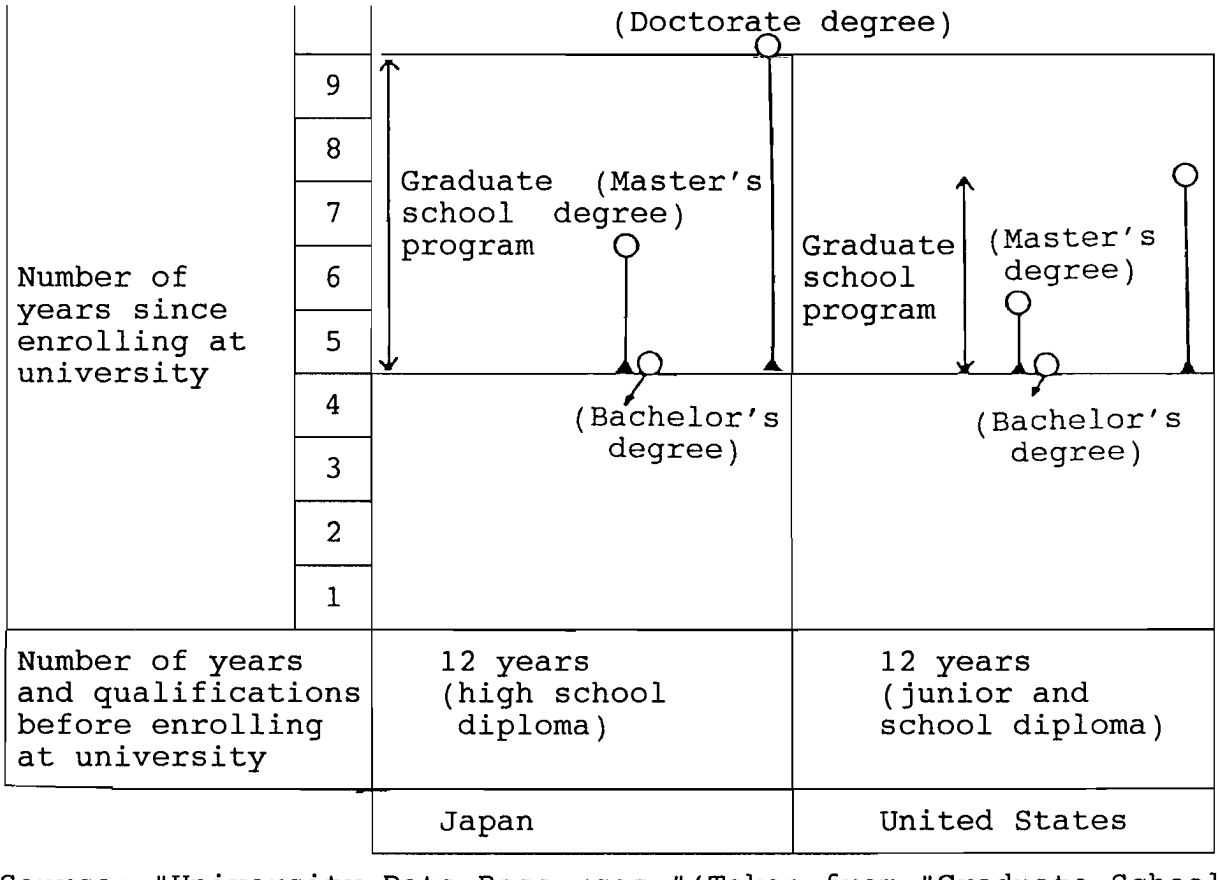
Figure 12 Comparison of Doctorate Systems in Japan and the United States



Shown in Figure 13 is the relationship between doctorate degreeacquisition and academic history plus number of years study at a graduate school.

Figure 13 Comparison Between the United States and Japan By Academic History and Number of Years Study at a Graduate School Before Obtaining a Doctorate Degree

	Conditions of Acquisition
Master	(1) Study for a minimum of one year (or 36 weeks) after obtaining a regular bachelor's degree, and 2 or 3 years of study under a university program (2) Study of two foreign languages in general (3) Submission of research dissertation paper which passes examination (4) At many universities, in addition to tests on each subject, the applicant must pass a comprehensive examination.
Doctor	(1) Study for a minimum of three years after obtaining a regular bachelor's degree (2) Study of two foreign languages in general (3) Submission of a research dissertation paper which passes examination (4) Successfully complete comprehensive examination and final examination



Source: "University Data Resources "(Taken from "Graduate School Syste in Leading Nations" by Teruhiko Wakana, reference document 14

(2) Types of Comparisons Between Japan and the U.S. by Number of Doctorates

In comparing the numbers of doctorates per unit population in Japan and the United States, the following two categories can be considered:

1) Number of course-work doctorates in Japan: Number of doctorates in the United States;
2) Total of number of course-work doctorates and dissertation doctorates in Japan: Number of doctorates in the United States.
   (This means a gross comparison in which dissertation doctorates over 35 years of age are included.)

In the case of category 2), however, since dissertation doctorates who obtained their degree at a late age are also included, the comparison might not always be appropriate.

In other words, it might be more rational in comparing numbersof doctorates to consider the development of research competence in conjunction with aging as well as the time period after receiving the doctorate degree during which the doctorate can function as a researcher.

First of all, with respect to the period during which the doctorate can function as a researcher, we must consider the fact that average age at which candidates who have completed the doctorate program in Japan receive their degrees is 29 years, whereas the median age of doctorate degree acquisition in the United States is 30 years.

Next, with respect to developing research competence, the predominant opinion is that the creativity of the researcher reachesa peak usually while he or she is in the 30s. (Refer to reference document 6, "Survey Report on Qualitative Improvements of Researchers and Full Utilization of Them Report No. 98 by Resources Council, Natural, Science and Technology Agency,1985)

In addition, the average age of researchers at private research institutions in Japan is 35 years. (Refer to reference document 7, "Survey on Full Utilization of Human Resources for Research in Leading Fields of Science and Technology," Reference data No. 132 of the National Institute of Resources, Science and Technology Agency, 1985)

Consequently, of all the dissertation doctorates, only those who have obtained the doctorate degree by submitting a dissertation before exceeding the age of 35 years should be considered as the equivalent of course-work doctorates, and in making a comparison with doctorates in the United States, only these subjects are appropriate.

Hence, in addition to categories 1) and 2) above, the following method of comparison can also be employed:

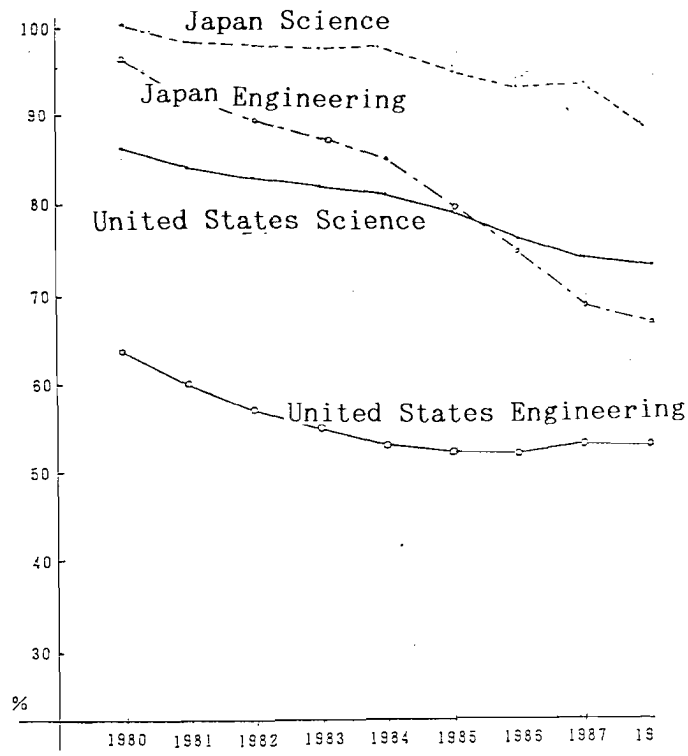
3) Number of course-work doctorates in Japan plus number of dissertation doctorates 35 years of age or younger (hereinafter referred to as 'Number of Young Doctorates') : Number of doctorates in the United States

(This means a net comparison in which dissertation doctorates are limited to those not more than 35 years of age.)

In both Japan and the United States, the number of foreign students has been increasing in recent years. A general outline of this situation is presented in the next figure, although further details are discussed later.

Accordingly, in addition to the three categories mentioned above, the types of comparison must be broken down still further to cover cases in which foreign students are included and cases in which they are excluded.

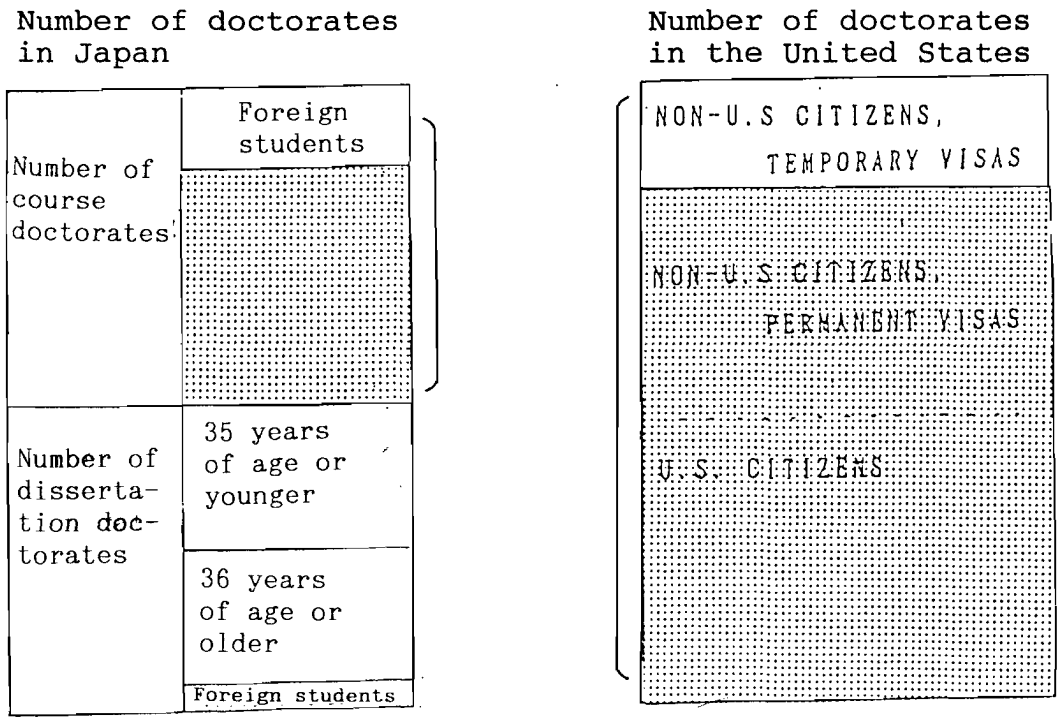
Figure 14. Percentages of Students Other Than Foreign Students in University Doctorate Program (Comparison of Japan and the United States)



Next, let us organize the types of comparison made thus far and present a general outline of them graphically. (In Figures 15 to 17, the portions marked by brackets are compared when foreign students are included, and the dotted portions are compared when foreign students are excluded.)

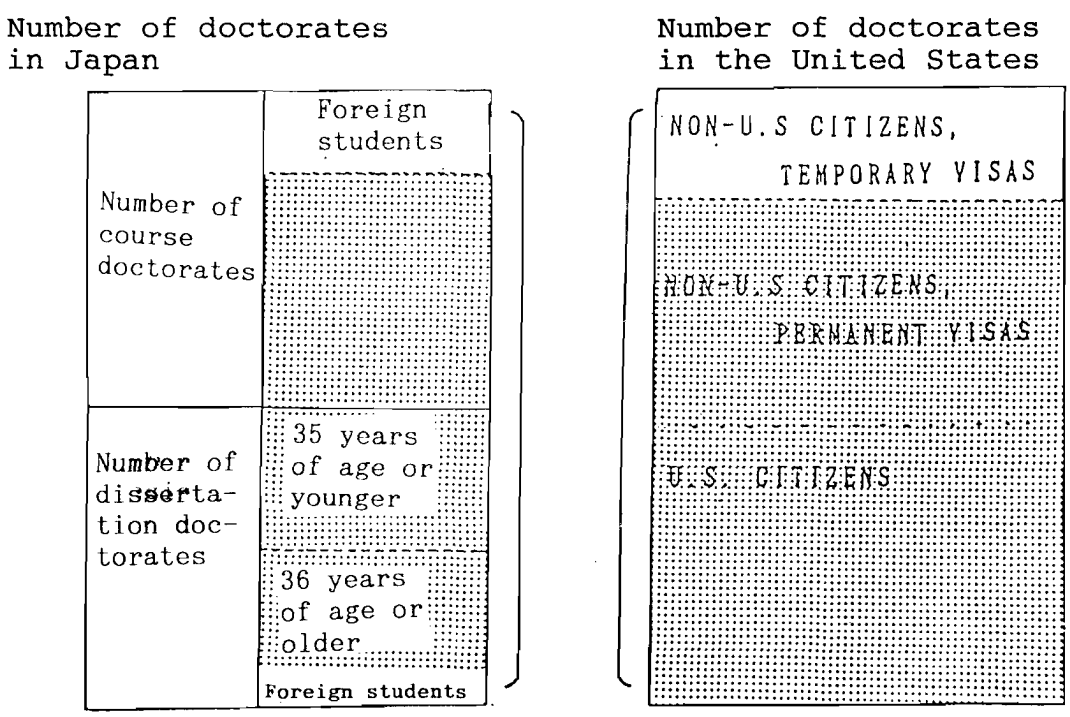
1) Number of course-work doctorates in Japan versus number of doctorates in the United States

Figure 15. Number of course-work doctorates in Japan vs Number of doctorates in the United States



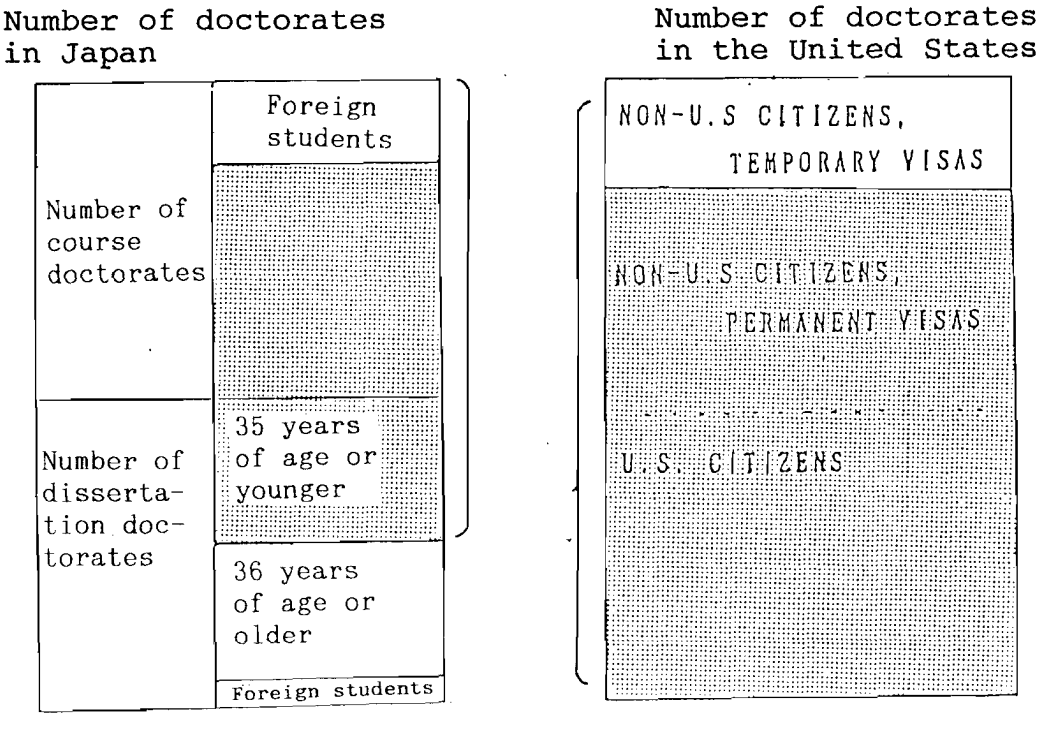
2) Comparison of total number of course-work and dissertation doctorates in Japan versus number of doctorates in the United States.
(This means gross comparison.)

Figure 16. Number of course-Work and dissertation doctorates in Japan vs Number of doctorates in the United States



3) **Comparison of number of young doctorates (total of course-work doctorates and dissertation doctorates 35 years of age or younger) versus number of doctorates in the United States**
(This means net comparison)

Figure 17. Number of young doctorates in Japan vs Number of doctorates in the United States



No data resources could be found to clarify the ages at which dissertation doctorates are obtained throughout Japan, although this information is essential for making the third type of comparison.

At the four universities mentioned earlier, namely, Tohoku University, University of Tokyo, Kyoto University and Kyushu University, (University of Tokyo excluded for 1989), the trend in the percentage of new dissertation doctorates 35 years old or younger out of the total number of dissertation doctorates is presented in Table 7.

Thus the percentages for the above four universities are taken as the percentage of new dissertation doctorates 35 years old or younger out of all dissertation doctorates nationwide. (For details, refer to Tables 11 to 18 of the attached statistics tables)

Table 7. Percentage of Doctorates 35 Years Old or Younger Among All Dissertation Doctorates

Fiscal year	Science doctorates	Engineering doctorates
1960	100%	75%
1965	58	41
1970	59	34
1988	33	23

Furthermore, in order to make a more accurate comparison of the number of young doctorates, the percentage of foreign students among all young dissertation doctorates must be considered.

Thus, in looking at the percentage of foreign residents among the total number of young dissertation doctorates at the three universities (Tohoku, Kyoto and Kyushu) in 1988, we find that the percentage was only 3 percent among science doctorates and only 4 percent among engineering doctorates. (For details, refer to Tables 14 and 18 of the attached statistics tables.)

These percentages were low, and although it was clear that the subjects had foreign citizenship, it was not always clear whether or not they were students, so it was decided that all the young dissertation doctorates would be regarded as having Japanese citizenship.

Since no data resources could be found to clarify the percentage of young dissertation doctorates among all those who obtained a dissertation doctorate between FY 1971 and FY 1987, it was assumed that the percentage of young dissertation doctorates during this period remained at the same level each year from FY 1970 to FY 1988, and the values used were obtained by making calculations based on this assumption. (For details, refer to Table 70 among the attached statistics tables.)

Ⅱ Comparison by Numbers of Science Doctorates

II Comparison by Numbers of Science Doctorates

1 Comparison by Number of Course-Work Doctorates
— Exceptionally small number of course-work doctorates as compared with the United States —

(1) Conditions of Advancement from Department to Master's Program, and from Master's Programs to Doctorate Programs
— High rate of Advancement throughout —

1) Advancement from Department to Master's Programs

— Advancement rate of 23 percent —

The rate of Advancement among graduates of science department to a graduate school science master's programs has been increasing steadily. The percentage of science department graduates who went on to a master's programs was 17 percent in 1980, and this percentage climbed to 23 percent in 1988 (24 percent in 1989). (See Tables 20 and 71 of attached statistics tables.)

During this same period, however, although the number of student enrollments in university master's programs increased 1.6 times (1.9 times in 1989), the number of applicants for admission to these master's programs rose by only 4 percent (7 percent in 1989). (See Table 21 and 71 of attached statistics tables.)

When this rate of increase in the number of applicants is compared with the rate of increase during the same period in the number of applicants for the engineering master's program (46 percent in(1989), we must admit that the state of application to the science master's program is quite depressed. (For details, refer to Table 28 and 71 of the attached statistics tables.)

Table 8. Rate of Advancement by Science Department Graduates

Year	Number of science dept. graduates	Number of master's programs enrollments	Rate of advancement
1980	11554	1941	16.8%
1985	12698	2445	19.3
1988	13388	3007	22.5
1989	13295	3135	23.6

Source: "Report of Basic Survey on Schools," (each year) by Ministry of Education, Science and culture. For 1989, however, values are immediate.

Note: For details, refer to Tables 20 and 71 of the attached statistics tables.

As shown in Table 9, the number of enrollments in 1987 in the university science master's programs did not reach the number of students prescribed (sufficiency rate = 0.9), but in 1989, the prescribed number of students was almost reached. The sufficiencyrate of the national universities exceeded 1 in 1989. (For details, see Table 71 of the attached statistics tables.)

Table 9. Sufficiency Rate of University Science Master's Programs

Year	1980	1985	1987	1989
Sufficiency rate	0.68	0.77	0.89	0.97

Source: University Data Resources (reference document 33). The rate for 1989, however, was calculated by the author from " Immediate Values of Report of Basic Survey on schools " by the Ministry of Education, Science and Culture in 1989 and from the "List of Universities Nation Wide" by the Ministry of Education, Science and Culture.
Note: For details on 1989, refer to Table 71 of attached statistics tables.

2) Future Careers of Those Who Complete Master's Programs

— Advancement rate of about 30 percent or more, Unemployment rate of around 5 percent —

The state of advancement by those who have completed the science master's programs in Japan has been exceptionally smooth, since a high percentage of these students want to continue with the octorate programs, and many obtain employment.

In 1988, the rate of advancement from the science master's programs to the university doctorate programs was 32 percent (31 percent in 1989); the rate of employment was 61 percent (63 percent in 1989) and the rate of unemployment was 4.9 percent (4.1 percent in 1989).

In comparison with 1980, the rates of academic progression and of unemployment fell somewhat but the rate of employment increased.

Table 10. Trend in Advancement of Those Who Complete University Science Master's Programs

Year	Rate of advancement to doctorate programs	Rate of employment	Rate of unemployment
1980	38%	49%	10.1%
1988	32	61	4.9
1989	31	63	4.1

Source: "Report of Basic Survey on School, " Ministry of Education , Science and Culture(each year). For 1989, however, values are immediate.

Note: For details on rate of progress to doctorate program, refer to Table 23 and 7 of the attached statistics tables. The rates of employment and of unemployment were calculated from Tables 25 and 71.

In comparison to the 8 to 9 percent of students who went on from the engineering master's programs to the doctorate programs 8 percent in 1989), the rate in the range of 30 percent of students who progressed from the science master's programs to the doctorate programs is an extremely high level.

Over the ten-year period concerned, however, the rate fell from 38 to 32 percent (31 percent in 1989). This decline has been steady, and it is extremely noteworthy as an indication that the high level has reached its peak.

In comparing the percentage of students who advancement from the science master's programs to the doctorate programs in Japan with the percentage in the United States, no general statement can be made because the format of university study is classified into "part time" and "full time".

Of all the students who obtained a master's degree by majoring in a field of science in the United States, the percentage who were full-time students at a graduate school in 1980 and in 1985 was around 30 percent.

And of all the students who obtained science master's degrees in the United States, excluding full-time university students, the percentage who became employed reached 94 percent in both 1980 and 1985. (For details, see Table 45 of attached statistics tables.)

3) Status Enrollment in Doctorates Programs

— enrollment rate at 1.1, sufficiency rate at 0.8 —

The numbers of students who enrolled in a science doctorate programs are given in Table 11. Taking 1980 as 100, the number of enrollment applicants in 1988 was 114 (131 in 1989) and the number of successful enrollments was 122 (141 in 1989).

Table 11. Trend in Number of Enrollments in University Science Doctorate Programs, Number of Applicants, Number of Those Who Completed Doctorate Programs Degree and Number of Doctorate Degree Awarded

Fiscal year	Number of enrollments	Number of applicants	Number of completed doctorate programs with degrees	Number of completed without degrees	Number of course-work doctorate degrees awarded	Subsequent degrees awarded
1980	657 (100)	772 (1.2)	300 (49%)	307	457	157
1985	689 (105)	784 (1.1)	348 (62)	216	497	149
1986	701 (107)	752 (1.1)	397 (66)	208	479	82
1987	845 (129)	910 (1.1)	393 (67)	196	464	71
1988	802 (122)	883 (1.1)				
1989	929 (141)	1014 (1.1)				

Source: For numbers of enrollments, applicants, course doctorate masters and graduates without degrees, " Report Basic Survey on School" by the Ministry of Education, Science and Culture (for each year). Values for 1989, however, are immediate.
For the number of course-work doctorate awards, "University Data Resources " compiled and edited by the Ministry of Education,Science and Culture (each issue).

Note: Completed without degree refers to"those students who have studied under the doctorate programs for longer than the prescribed time limit, students who have obtained all the prescribed credits but who have been completed without taking an academic degree."
In the enrollments column, the figures in parenthesis are derived when 1980 is taken as 100.
In the applicants column, the figures in parenthesis denote number of applicants divided by number of enrollments.
In the completed doctorate programs with degrees column, the figures in parenthesis denote number of completed doctorate programs with degrees divided by number of completed doctorate programs with degrees plus number of completed without degrees.
The number of subsequent degrees awarded refers to the

number of completed without degrees who later obtained the course-work doctorate degree. It was determined by subtracting the number of completed doctorate programs with degrees from the number of course-work doctorate degrees awarded.
For details, refer to Tables 3, 24, 42 and 71 of the attached statistics tables.

The number of enrollments in the university doctorate program does not equal the prescribed number of enrollments.

The corresponding sufficiency rate (enrollments/prescribed number thereof) was 0.68 in 1980 and 0.79 in 1987 (0.88 for the national universities). In 1989, however, the rate for all the universities fell to 0.71 while the rate for the national universities rose to 0.97. In considering this trend, allowance must be made for the fact that foreign students have been included in the number of enrollments.

Table 12. Prescribed Number of Enrollments in University Science Doctorate Programs, Actual Number of Enrollments and Sufficiency Rate

Year	Prescribed enrollments	Actual enrollments	Sufficiency rate	(National universities)
1980	971	657	0.68	(0.76)
1985	1029	689	0.67	(0.77)
1987	1074	845	0.79	(0.88)
1989	1300	929	0.71	(0.97)

Source: "University Data Resources" compiled by Ministry of Education, Science and Culture (reference document 33). For 1989, however, figures were compiled by the author from " Immediate Values of Report of Basic Survey on Schools" by the Ministry of Education, Science and Culture and from its " List of Universities Nationwide."

On the other hand, in the United States, of all those who obtained a science master's degree at a university, the percentage who continued to study as full-time or part-time students (We can assume that practically all of them are working for the doctorate.) went from 38 percent in 1980 to 41 percent in 1985.

Table 13. Percentage of Science Masters Who Continue University Study in the United States

Year	Number of masters(1)	Number of subsequent full-time students(2)	Number of subsequent part-time students(3)	Advancement rate {(2)+(3)}/(1)
1980	12800	3800	1000	38%
1985	15800	5100	1300	41

Source: NSF "characteristics of recent science/engineering graduates" (1982, 1984, 1988.)
Note: For details, refer to Table 45 of the attached statistics tables.

4) Rate of Doctorate Degree Acquisition

— Acquisition rate at 67 percent —

The rate of those who obtained the doctorate degree in 1981 was 49 percent, out of 607 people, the number of those who total of completed doctorate Programs with degrees and completed without degrees and the rate in 1988 was 67 percent out of 589 people. This percentage has been steadily rising, but it is still slightly lower than the percentage of engineering doctorates. (For details, refer to Table 42 of the attached statistics tables.)

What is more, the percentage of foreign students who obtain the science (not limited to science or engineering) doctorate tends to be higher than that of Japanese. (For details, refer to Table 44 of the attached statistics tables.)

Furthermore, among the graduates without degrees, that is, those studied under the doctorate programs but graduate without taking the degree, there are some who become course-work doctorates at a later date after submitting a dissertation paper. Nevertheless, there is a substantial number of students who ultimately cannot become course-work doctorates. (It is safe to assume that this number is proportionate to the number obtained when the number of subsequent degree holders is subtracted from the number of graduates without degrees. The same also applies hereinafter for engineering doctorates.)

(2) Comparison by Number of Course-Work Doctorates

— From 1/10th to 1/7th the number in the United States —

1) Comparison by Number of Doctorates with Foreign Students Included

— 1/10th the number in the United States —

In Japan, the number of science course-work doctorates per unit population stood at 0.39 persons in 1981 (fiscal 1980). In 1988(fiscal 1987), the figure was 0.38 persons, so there was not much of a change.

Table 14. Number of Science Doctorates Per Unit Population: Japan vs the United States (For Japan, comparison by number of course-work doctorates)

Year	Japan	United States
1981	0.39 people(100)	3.36 people(861)
1988	0.38 (100)	3.61 (950)

Note: For details on sources, computation methods and reference documents, refer tables 38 and 48 of the attached statistics tables. For Japan, 1981 represents the number of doctorates per unit population in fiscal 1980 and 1988 represents the same in fiscal 1987.

By contrast, the number of science doctorates per unit population in the United States increased slightly from 3.36 persons in 1981 to 3.61 persons in 1988.

Hence the number of science course-work doctorates per unit population in Japan amounts to about one-tenth the number in the United States.

2) Comparison by Number of Doctorates with Foreign Students Excluded

— 1/7th the number in the United States —

Next, of all the course-work doctorates, let us consider the number of doctorates, exclusive of foreign students, who hope to become involved in activities of science and technology in Japan.

Estimating from the percentages of foreign students given in Table 15, the numbers of foreign students in the total numbers of course-work doctorates are as listed in Table 16.

Table 15. Number of Foreign Students Among Those Studying Under the Science Doctorate Programs

Year	Total number of students	Number of foreign students	Percentage of foreign students
1981	2471	37	1.5%
1984	2485	72	2.9
1886	2524	198	7.8
1987	2678	194	7.2
1888	2829	304	10.7

Source: Number of students obtained from "Report of Basic Survey on Schools " by Ministry of Education, Science and Culture (each year).
Number of foreign students was investigated by the author with reference to data resources of the Asia Student Culture Association, Inc. (reference documents 43 to 46). Figures for 1987, however, were compiled by the autho from " University Data Resources " (reference document 33).
Note: For details, refer to Table 35 of the attached statistics tables.

Table 16. Number of Japanese Course-Work Doctorates vs Number of Foreign Student Course-Work Doctorates

Fiscal year	1980	1981	1982	1983	1984	1985	1986	1987
Number of course-work doctorates	457	433	429	397	459	497	479	464
Number of Japanese doctorates	455	429	423	389	448	483	454	428
Number of foreign student doctorates	2	4	6	8	11	14	25	36

Note: For details on sources, computation methods, etc., refer to Table 39 of attached statistics tables.

As a result, the number of science course-work doctorates remaining after the numbers of foreign students have been excluded were derived as shown in Table 17. The number fell about 10

percent from 0.39 persons in 1981 (fiscal 1980) to 0.35 persons in 1988 (fiscal 1987).

Table 17. Number of Science Course-Work Doctorates Per Unit Population Exclusive of Foreign Students: Japan vs the United States (For Japan, Comparison by Number of Course-Work Doctorates)

Year	Japan	United States
1981	0.39 persons (100)	2.84 persons (728)
1877	0.35 (100)	2.62 (748)

Source: Same as Table 14. However, the number of doctorates in Japan exclusive of foreign students was calculated based on the numbers of foreign students listed in Table 15. The numbers of doctorates in the United States were derived from NSF reference documents (No. 37 and 41).
Note: For details on computation method, reference documents, etc., refer to Tables 39 and 50 of the attached statistics tables.

In the United States, those who hope to become engaged in scientific and technological activities are considered to be science doctorates who are U.S. citizens or permanent residents (equivalent to the number of those in Japan Excluding Foreign Students). Looking at these subjects alone, the number of doctorates per unit population declined from 2.84 persons in 1981 to 2.62 persons in 1988.

Of all course-work doctorates except foreign students in Japan, the number of science doctorates per unit population is equal to about 1/7th the number in the United States.

2 Comparison by Total of Number of Course-Work Doctorates and Number of Dissertation Doctorates

— With foreign students excluded, about 1/4th the number in the United States —

(1) Trend in Number of Science Doctorates Among Course-Work Doctorates and Among Dissertation Doctorates

— Percentage of course-work doctorates at 55 percent —

The number of science doctorates that obtains when dissertation doctorates are added to course-work doctorates becomes 102

in 1988 (fiscal 1987) when 1981 (fiscal 1980) is taken as 100.

Table 18. Trend in Number of Science Doctorates and in Percentage of dissertation Doctorates Among Them

Fiscal Year	Number of course-work doctorates		Number of dissertation doctorates		Total	
	number of persons	index	number of persons	index	number of persons	index
1957	47		0		47	
1960	139		23		162	
1970	323		287		610	
1980	457	100	365	100	822	100
1985	497	109	363	99	860	105
1986	479	105	341	93	820	100
1987	464	102	373	102	837	102

Source: Compiled by author from "University Data Resources" by the Ministry of Education, Science and Culture (each year, reference documents 10 to 33).
Note: For details, refer to Table 3 of attached statistics tables.

As shown in Table 1, the percentage of dissertation doctorates in the total number of doctorates reached 45 percent in 1988 (fiscal 1987).

The percentages of dissertation doctorates are distinguished somewhat by university. Of the total numbers for the eight univerities of Hokkaido, Tohoku, Tokyo, Tokyo Institute of Technology, Nagoya, Kyoto, Osaka and Kyushu, the percentages of dissertation doctorates were low as compared with other national universities, but the percentages of course-work doctorates were high. (For details, see Table 6 of the attached statistics tables.)

Table 19. Percentages of Science Dissertation Doctorates by University

Fiscal year	8 universities	Other national universities	Waseda University	Other private universities
1971	42	66	13	45
1975	45	59	29	55
1980	39	60	22	47
1985	36	65	44	45
1986	38	52	38	56

Source: "University Data Resources" by the Ministry of Education, Science and Culture (each year, reference documents 10 to 33).
Note: For details, refer to Table 6 of attached statistics tables.

(2) Comparison by Total of Number of Course-Work Doctorates and Number of Dissertation Doctorates

— From 1/5th to 1/4th the number in the United States —

If dissertation doctorates are added to course-work doctorates and foreign students are included, the number of science doctorates per unit population in Japan in 1988 (fiscal 1987) was 0.69 persons, which is about 1/5th the number in the United States in the same year.

If dissertation doctorates are added to course-work doctorates but foreign students are excluded, the number of science doctorates per unit population in Japan in 1988 (fiscal 1987) was 0.66 persons, while number of science doctorates per unit population in the United States, comprised of U.S. citizens and non-U.S. citizens with permanent visas, was visas 2.62 persons. Thus the number in Japan was about 1/4th that in the United States.

As noted above, although there has been a substantial increase in the number of foreign students studying under a university science doctorate program, when comparison is made with the number of dissertation doctorates added, the effect of the foreign students is still not very remarkable.

Table 20. Total Number of Science Doctorates Per Unit Population: Japan vs the United States (For Japan, comparison is by total of course-work and dissertation doctorates.)

Year	Total number		Excluding foreign students	
	Japan	United States	Japan	United States
1981	0.70	3.36	0.70 (100)	2.84 (406)
1988	0.69	3.61	0.66 (100)	2.62 (397)

Source: Same as Tables 14 and 17.
Note: For details, refer to Tables 48, 50, 66 and 68 of attached statistics tables.

3 Comparison by Number of Young Doctorates

— By comparison with foreign students excluded, 1/6th the number in the United States —

As shown in Table 21, the number of young science doctorates total of course-work doctorates and dissertation doctorates not more than 35 years old) per unit population, with foreign students included, in Japan was 16 percent of the number in the United States in 1981 (fiscal 1980) and 13 percent in 1989 (fiscal 1987).

Table 21. Total Number of Young Science Doctorates Per Unit Population: Japan vs the United States
(For Japan, comparison is by total of course-work and young dissertation doctorates.)

Year	Total number		Excluding foreign students	
	Japan	United States	Japan	United States
1981	0.53	3.36	0.53 (100)	2.84 (536)
1988	0.48	3.61	0.45 (100)	2.62 (582)

Source: Same as Tables 14 and 16.
Note: For details on computation methods, refer to Table 70 of attached statistics tables.

The number of young doctorates per unit population excluding foreign students was 19 percent of the number in the United States in 1981 (fiscal 1980) and 17 percent in 1988 (fiscal 1987).

Ⅲ Comparison by Number of Engineering Doctorates

III Comparison by Number of Engineering Doctorates

1 Comparison by Number of Course-Work Doctorates

— Gap with the United States expanded slightly —

(1) Condition by Advancement from Department to Master's Programs and from Master's Programs to Doctorate Programs

— Advancement rate slightly lower than for science —

1) Advancement from Department to master's programs

— Advancement rate of around 16 percent —

The number of students who graduate from an engineering department and advance to a master's programs has been steadily increasing. The rate of this advancement rose from 10 percent in 1980 to 16 percent in 1988 (17 percent in 1989). (For details, see Table 27 of the attached statistics tables.)

With 1980 taken as 100, the number of enrollment applicants rosesharply to 141 in 1988 (146 in 1989) and the number of enrollments rose to 173 (178 in 1989). (For details, refer to Tables 28 and 71 of the attached statistics tables.)

Table 22. Rate of Advancement by Engineering Department Graduates

Year	Number of dept. graduates graduates	Number of master's programs enrollments	Rate of advancement
1980	73508 persons	7213 persons	9.8%
1985	71396	9905	13.9
1988	76362	12314	16.1
1989	75678	12514	16.5

Source: "Report of Basic Survey on Schools(each year)" Ministry of Education, Science and Culture for 1989, however, values are immediate.
Note: For details, refer to Tables 27 and 71 of the attached statistics tables.

The number of enrollments in a university engineering master's program, which did not satisfy the prescribed number of enrollments in 1980 (enrollments/prescribed enrollments = suffi-

ciency rate = 0.8), surpassed the prescribed number of enrollments in 1987 (sufficiency rate = 1.2), and in 1989 the sufficiency rate climbed to 1.32. Also, the sufficiency rate for the national universities in 1989 reached 1.38, which was slightly higher than for all universities. (For details on 1989, see Table 71 of attached statistics tables.)

Table 23. Sufficiency Rate of University Engineering Master's Programs

Year	1980	1985	1987	1989
Sufficiency rate	0.81	1.08	1.20	1.32

Source: "University Data Resources"(reference document 33). The rate for 1989, however, was calculated by the author from " Immediate Values of Report of Basic Survey on Schools " by the Ministry of Education, science and culture. and " List of Universities Nationwide."

Note: For details, refer to Table 71 of attached statistics tables.

2) Futue Careers of Advancement by Those Who Complete Master's Programs

— Advancement rate of under 10 percent, employment rate of under 90 percent —

The Status of Advancement those who complete the master's programs in engineering at a university in Japan can be summarized as follows: a low rate of advancement to the doctorate program and a high rate of employment.

The rate of advancement to a university doctorate program in 1988 was 9 percent (8 percent in 1989); the rate of employment was 88 percent (89 percent in 1989), and the rate of unemployment was 2 percent (1 percent in 1989).

In the United States, the percentage of all engineering masters, excluding currently full-time university students, who obtained employment was around 97 percent in 1980 and 95 percent in 1985. The percentages of full-time university students were 13 percent in 1980 and 15 percent in 1985. (See Table 45 of theattached statistics tables.)

Table 24. Trend in Advancement of Those Who Complete University Engineering Master's Programs

Year	Rate of advancement to doctorate programs	Rate of employment	Rate of unemployment
1980	8%	88%	2.5%
1888	9	88	1.6
1878	8	89	1.2

Source: "Report of Basic Survey on Schools", Ministry of Education, Science and Culture(each year). for 1989, however, values are immediate.

Note: For details, Refer to Tables 31, 32, and 71 of the attached statistics tables. Employment rates and unemployment rates were compiled from Tables 32 and 72.

3) Status Enrollment in Doctoral Programs

— Enrollment rate of 1.1 and sufficiency rater of about 0.5 —

The number of enrollments in the university engineering doctorate program has been steadily increasing.

With 1980 taken as 100, enrollments increased to 195 in 1988 (197 in 1989) and enrollment applicants rose to 181 (186 in 1989).

Moreover, as shown in Table 24, the rate of advancement during thisperiod after completing the engineering master's program went from 8 to 9 percent (8 percent in 1989).

Nevertheless, the rate of advancement for engineering, at 9 percent(8 percent in 1989), was only around one-fourth the rate of advancement for science students in Japan, manifesting a slight increase at a low level.

Table 25. Trend in Number of Enrollments in University Engineering Doctorate Programs, Number of Applicants, Number of Those Who Completed Doctorate Programs and Number of Doctorate Degree Awards

Fiscal year	Number of Enrollments	Number of applicants	Number of completed doctorate programs with degree	Number of completed without degrees	Number of course-work doctorate degrees awarded	Number of subsequent degrees awarded
1980	638 (100)	745 (1.2)	369 (54%)	316	523	154
1985	832 (130)	917 (1.1)	406 (69)	182	480	74
1986	1089 (171)	1192 (1.1)	434 (68)	204	505	71
1987	1062 (167)	1161 (1.1)	519 (72)	202	621	102
1988	1244 (195)	1350 (1.1)				
1989	1258 (197)	1384 (1.1)				

Note: Sources, etc., are the same as for Table 11. For details, see Tables 7, 30, 53 and 71 of attached statistics tables.

The number of enrollments in the university doctorate program did not reach half the number prescribed. The sufficiency rate (enrollments/prescribed enrollments) was 0.28 in 1980 and 0.42 in 1987 (0.52 for national universities). The sufficiency rate in 1989 for all universities was 0.49 (0.61 for national universities). Since foreign students are included in the number of enrollments, it must be remembered that increases in the numbers of foreign students are reflected in the sufficiency rates.

Table 26. Prescribed Number of Enrollments in University Engineering Doctorate Program, Actual Number of Enrollments, and Sufficiency Rate

Year	Prescribed enrollments	Actual enrollments	Sufficiency rate	(National universities)
1980	2256	638	0.28	(0.33)
1985	2377	832	0.35	(0.44)
1987	2515	1062	0.42	(0.52)
1989	2560	1258	0.49	(0.61)

Source: "University Data Resources" compiled by Ministry of Education, Science and Culture (reference document 33). Figures for 1989 were compiled by the author from the Ministry of Education,Science and Culture's "Immediate Values of Report of Basic Survey on Schools" and its "List of Universities Nationwide."

Note: For details on 1989, refer to Table 71 of attached statistics tables.

The rate of academic advancement by engineering masters in the United States is higher than in Japan, at 23 percent in 1980 and 21 percent in 1985.

Table 27. Percentage of Engineering Masters Who Continue University Studying in the United States

Year	Number of masters (1)	Number of subsequent full-time students(2)	Number of subsequent part-time students(3)	Academic advancement rate (2)+(3) / (1)
1980	15400	2000	1600	23%
1985	29600	4300	2000	21

Source: NSF "characteristics of recent science/engineering graduates" (1982, 1984, 1988)

Not: For details, refer to Table 45 of attached statistics tables.

Of all the students who obtained a master's degree in an engineering field in the United States, the percentage who are currently full-time students at a university was 13 percent in 1980 and 15 percent in 1985. (For details, see Table 45 of attached tables.)

4) Rate of Doctorate Degree Acquisition

— Acquisition rate of about 70 percent —

The rate of those who obtained the doctor's degree in 1980 was 56 percent out of 657 people, the number of those who total of completed doctorate programs with degree and completed without degree. and 72 percent out of 721 people in 1988; these percentages are slightly higher than for the science category and they have been increasing each year.

With respect to number of course-work doctorates in the fiscalyear, the following two points apply about equally for engineers and for scientists: 1) the number of students who graduate without a degree but who obtain one subsequently in a later year is increasing, and 2) among the graduates without degrees, a substantial number are able to obtain the doctor's degree in a later year. (For details, see Table 43 of attached tables.)

(2) Comparison by Number of Course-Work Doctorates

— From 1/4 to 1/2.5 of the United States —

1) Comparison by Number of Doctorates with Foreign Students Included

— 1/4 of the United States —

In Japan, the number of engineering course-work doctorates per unit population, with foreign students included, went from 0.45 persons in 1981 (fiscal 1980) to 0.51 persons in 1988 (1987), for an increasem of 13 percent.

In the United States, on the other hand, the number of engineering doctorates per unit population climbed from 1.20 persons in 1981 to 1.91 persons in 1988 for an increase of 59 percent.

This means that the number of engineering course-work doctoratesper unit population in Japan, with foreign students included, amounted to 33 percent of the number in the United States in 1981 (fiscal 1980), but dropped to 27 percent by 1988 (fiscal 1987), indicating that the gap between the two nations has been widening.

Table 28. Number of Engineering Doctorates Per Unit Population: Japan vs the United States
(For Japan, comparison by number of course-work doctorates.)

Year	Japan	United States
1981	0.45 people (100)	1.20 people (267)
1988	0.51 (100)	1.91 (375)

Source: Same as for Table 14.
Note: For details on computation methods, reference documents, etc., Refer to Tables 40 and 49 of the attached statistics tables.

2) Comparison by Number of Doctorates with Foreign Students Excluded

— 1/2.5 of the United States —

As shown in Table 29, there has been a marked increase in recent years in the number of foreign students engaged in a university engineering doctorate programs.

Table 29. Number of Foreign Students Among Those Studying Under The Engineering Doctorate Programs

Year	Total number of students	Number of foreign students	Percentage of foreign students
1981	2218	194	8.7%
1984	2223	337	15.2
1986	2820	724	25.7
1987	3196	1010	31.6
1988	3639	1170	32.2

Source: Number of students obtained from "Report of Basic Survey on schools" by Ministry of Education, science and culture (each year).
Number of foreign students was investigated by the author with reference to data resources of the Asia Student Culture Association, Inc. (reference documents 43 to 46). Values for 1987, however, were compiled by the author from "Universities Data Resources" (reference document 33)
Note: For details, refer to Table 37 of attached statistics tables.

In other words, looking at the total of all universities nationwide, from 1981 the number of students enrolled in a university engineering doctorate programs has been increasing, as shown in Table 30, and sizable portions of these increases have been taken up by foreign students.

Table 30. Increase in Number of Students in Engineering Doctorate Programs and Increase in Number of Foreign Students

Year	1981-1984	1984-1986	1986-1987	1987-1988
Increase in number of enrolled students	5	597	376	443
Increase in number of foreign students	143	387	286	160

Note: For details, refer to Tables 33, 36 and 37 of attached statistics tables.

The percentage of foreign students varies with the university and the major subject.

Let us look at the differences by university by taking the example of Tohoku University. As shown in Table 31, the number of students engaged in a graduate school engineering doctorate program at Tohoku University, with foreign students excluded, has been declining each year, and the percentage of foreign students among these students was 47 percent in 1988. This is considerably higher than the nationwide average, as indicated in Table 29, but these percentages were also said to be in excess of 40 percent at Tokyo Institute of Technology and at Kyushu University. (From the Japan Economic Journal of August 17, 1989)

Table 31. Trend in Number of Students Enrolled in Engineering Doctorate Program at Tohoku University

Year	1981	1984	1986	1988
Number of students enrolled in doctorate program	144	148	180	259
Number of foreign students	16	38	78	121
Percentage of foreign students	11%	26%	43%	47%

Source: The Tohoku University Enrollment Guide was used for number of students enrolled in doctorate programs. Number of foreign students was determined by author with reference to data resources of the Asia Student Culture Association, Inc. (reference documents 43 to 46)

The percentage of foreign students also varies with the major subject.

Let us consider this variation by taking the example of University of Tokyo. The results shown in Table 32 were obtained by examining the roster of graduates from University of Tokyo. During the period, moreover, the average value for engineering as a whole was between 23 and 25 percent.

Table 32. Trend in Percentage of Foreign Students Among Students Who Complete the Engineering Doctorate Programs at University of Tokyo

Year	1985	1986	1987	1988	1989
Civil engineering & construction	25%	71%	47%	57%	71%
Electrical & electronics	29%	26%	17%	27%	33%
Chemistry	0%	11%	11%	21%	4%

Source: Roster of completed University of Tokyo Engineering Department

When foreign students are excluded, the number of engineering course-work doctorates continued to diminish from 1981, as shown in Table 33, and reached a bottom in 1984, then turned upward again, reaching the same level in 1987 as was prevalent five years earlier.

Table 33. Trend in Number of Japanese Engineering Course-Work Doctorates

Fiscal year	1980	1981	1982	1983	1984	1985	1986	1987
Number of course-work doctorates	523	541	506	489	447	480	505	621
(index)			(100)	(97)	(88)	(95)	(100)	(123)
Number of Japanese course-work doctorates	501	506	462	436	389	407	402	461
(index)			(100)	(94)	(84)	(88)	(87)	(100)
Number of foreign student doctorates	22	35	44	53	58	73	103	160

Note: For details on computation methods and reference documents, refer to Tables 37, 40 and 41 of attached statistics tables.

The number of engineering course-work doctorates in Japan when foreign students are excluded dropped from 0.43 persons in 1981 (fiscal 1980) to 0.38 persons in 1988 (fiscal 1987), as shown in Table 34.

Table 34. Number of Engineering Doctorates Per Unit Population Exclusive of Foreign Students: Japan vs the United States (For Japan, comparison by number of course-work doctorates)

Year	Japan	United States
1981	0.43 persons (100)	0.72 persons (167)
1988	0.38 (100)	1.00 (263)

Source: Same as Table 14. The number of doctorates in Japan exclusive of foreign students, however, was computed from the number of foreign students in Table 29.

Note: For details on computation method and reference documents, refer to Tables 41 and 51 of attached statistics tables.

Looking at the United States from the same perspective, we note that the number of doctorates per unit population, when

limited to U.S. citizens and non-U.S. citizens with permanent visas (corresponds to figures on Japan exclusive of foreign students), climbed from 0.72 persons in 1981 to 1.00 persons in 1988.

In other words, taking 1981 as 100, while the figure for Japan dropped to 88 in 1988 (fiscal 1987), the figure for the United States swelled to 139. As a result, the number of engineering doctorates per unit population in Japan, which amounted to 60 percent of the U.S. figure in 1981, fell to 38 percent in 1988(fiscal 1987), making Japan even more disparate from the United States.

2 Comparison by Total of Number Course-Work Doctorates and Number of Dissertation Doctorates

— Surpasses the United States when foreign students are excluded —

(1) Trend in number of engineering doctorates A mong course-work doctorates and Among dissertation doctorates

— Higher relative weight to dissertation doctorates —

Of all the engineering doctorates awarded per year, the percentage of dissertation doctorates exceeded 50 percent from fiscal 1963. This is a major distinctive feature among engineering doctorates in Japan. (For details, see Table 7 of the attached statistics tables.)

The total number of engineering doctorates, with dissertation doctorates added to course-work doctorates, swelled by a wide margin to 130 in 1987, with 1980 taken as 100.

The rate of increase over this period, while being 20 percent for course-work doctorates, was 40 percent for dissertation doctorates.

Table 35. Trend in Number of Engineering and in Percentage of Dissertation Doctorates Among Them

Fiscal Year	Number of course-work doctorates		Number of dissertation doctorates		Total	
	number of persons	index	number of persons	index	number of persons	index
1957	25		0		25	
1960	72		6		78	
1970	425		428		853	
1980	523	100	663	100	1186	100
1985	480	92	924	139	1404	118
1986	505	97	988	149	1493	126
1987	621	119	926	140	1547	130

Source: Compiled by author from "University Data Resources," by the Ministry of Education,Science and Culture (each issue, reference documents 10 to 33)
Note: For details, refer to Table 7 of the attached statistics tables.

Let us now look at the disparities by university.

In the total of eight universities (Hokkaido, Tohoku, Tokyo,Tokyo Institute of Technology, Nagoya, Osaka and Kyushu), the percentage of dissertation doctorates from fiscal 1972 was lower than for other national universities, while the percentage of course-work doctorates was higher. In light of the fact that for science the percentage of dissertation doctorates was lower in the total figure for the eight universities than for other universities, it becomes apparent that the pattern for engineering doctorates is opposite to that for the science doctorates. (For details, refer to Table 10 of the attached statistics tables.)

Table 36. Percentages of Engineering Dissertation Doctorates by University

Fiscal year	8 universities	Other national universities	Waseda University	Keio gizyku University	Other private universities
1971	50	-	52	36	33
1975	52	-	53	63	67
1980	56	40	43	42	70
1985	66	32	72	39	72
1986	67	41	66	49	68

Source: "University Data Resources" by the Ministry of Education, Science and Culture (each issue, reference documents 10 to 33) Note: For details, refer to Table 10 of the attached statistics tables.

(2) Comparison by Total of Number of Course-Work Doctorates and Number of Dissertation Doctorates

— in excess of the United States —

The number of engineering doctorates per unit population th dissertation doctorates added to course-work doctorates plus foreign students in Japan amounted to 1.27 persons in 1988 (fiscal 1987), a value which approached somewhat the value for the United States in the same year.

The number of engineering doctorates per unit population in Japan, exclusive of foreign students, in 1988 was 1.13 persons. The number of engineering doctorates in the United States per unit population including U.S. citizens and non-U.S. citizens with permanent visas was 1.00, so in the comparison, Japan exceeds the United States. This is because there are more foreign students in the United States.

Table 37. Total Number of Engineering Doctorates Per Unit Population: Japan vs the United States (For Japan, comparison is by total of course-work and dissertation doctorates.)

year	Total number		Exclusive of foreign students			
	Japan	United States	Japan		United States	
1981	1.01	1.20	0.99	(100)	0.72	(72)
1988	1.27	1.91	1.13	(100)	1.00	(88)

Source: Same as Tables 13 and 32.
Note: For details, refer to Tables 49, 51, 67 and 69 of attached tables.

3 Comparison by Number of Young Doctorates

— One half that of the United States with foreign students excluded —

The number of young engineering doctorates (total of course-work doctorates and dissertation doctorates not more than 35 years old) per unit population in Japan, including foreign students, came to 51 percent of the number in the United States in 1981 (fiscal 1980), as shown in Table 38, then dropped to 36 percent in 1988 (fiscal 1987).

The number of young engineering doctorates per unit population in Japan, excluding foreign students, came to 82 percent of the number in the United States in 1981, then dropped to 56 percent in 1988.

Table 38. Total Number of Young Engineering Doctorates Per Unit Population: Japan vs the United States (For Japan, comparison is by total of course-work and young disser-

Year	Total number		Exclusive of foreign students			
	Japan	United States	Japan		United States	
1981	0.61	1.20	0.59	(100)	0.72	(122)
1988	0.69	1.91	0.56	(100)	1.00	(179)

Source: Same as Tables 14 and 34.
Note: For details on computation method, refer to Table 70 of attached statistics tables.

Ⅳ Treatment and Evaluation of Those Who Complete Doctorates Programs

IV Treatment and Evaluation of Those Who Complete Doctorates Programs

The number of course-work doctorates in Japan per unit population of 100,000, not including foreign students, was small for both science and engineering in 1988 (fiscal 1987) than in 1981 (fiscal 1980).

The number of science course-work doctorates in Japan is the most conspicuously low in comparison to the United States. Amid these conditions, moreover, the number of course-work doctorates appears to be steadily diminishing. What is more, for the sciences, although the rate of advancement to university doctorate programs among science department graduates has remained about the same over the last several years, the rate of advancement from a university master's programs has been declining. (For details, refer to Tables 23 and 71 of the attached statists tables.)

Among engineering doctorates, the number of course-work doctorates in Japan has been declining. This trend does not change even if dissertation doctorates not more than 35 years old are added (refer to Table 38). By contrast, the trend in the United States is toward increase (refer to Table 34). Amid these conditions, in engineering fields, the rate of advancement by department graduates to a university doctorate programs and the rate of advancement from a master's programs hover at around 8 percent. (For details, refer to Table 31 and 71 of attached statistics tables.)

The fact that the number of students in a university doctorate programs, with foreign students included, is less than the cribed number is indicated by Table 12 for science and by Table 26 for engineering. In view of this fact, it is reasonable to assume that the rates of advancement have been sluggish.

In view of the fact that the rate of advancement from department graduate to university master's programs has been rising fer to Tables 20 and 27 of attached statistics tables) and the fact that the unemployment rate among those who complete the master's programs has been falling (Tables 25 and 32), the university master's programs both in science and in engineering has become extremely attractive both to department graduates and to business enterprises.

On the other hand, the rate of advancement to the university doctorate programs has remained sluggish, and we shall examine the reasons from the standpoint of both students and business enterprises.

1 Doctorates programs as Viewed by Students

— heavy economic burden and low employment rate —

In an interview survey (see reference document 50) conducted on university professors by the Science and Technology Agency,

the following reasons were given by the professors for why students do not advance to the doctorate programs.

1) Remaining without an income up to the age of 30 constitutes a heavy economic and psychological burden.

2) It is not always possible to obtain a doctorate degree within three years.

3) Employment can easily be obtained after completing the master's programs but there is much uncertainty about finding employment after completing the doctorate programs. (The academic work is not always evaluated fairly, for example, and doctorates are not always welcomed.)

4) The research facilities of universities are inferior to private research institutions.

Of the four reasons mentioned above, the first is especially significant because in Japanese society students must depend almost entirely upon their parents to cover their expenses and this puts an exceptionally high economic burden on those who continue study under a doctorate program.

(1) Economic Support for Those Studying Under a Graduate School Doctorates Programs

In Japan, economic support for students enrolled in university doctorate programs is provided by such institutions as the fund for special researchers of the Japan Society for the Promotion of Science (monthly allowance of 128,000 yen in 1989), the scholarship grant of the Japan Scholarship Foundation (monthly allowance of 83,000 yen in 1989), and scholarship grants by corporations, etc. The numbers of students who received scholarship grants from the Foundation are shown in Table 39.

Table 39. Economic Support to Students in University Doctorate Programs

Number of students in doctorate programs	Fiscal 1987	
Science	2678 students	
Engineering	3196	
Number of students who receive economic support		
Number of special researchers fund recipients (doctorate program students only)		
(Science and Engineering) fiscal 1985	59 students	(8% of applicants)
1986	89	(16% of applicants)
1987	137	(26% of applicants)
Japan Scholarship Foundation	Enrolled students	9871
	Scholarship students	7247 (73%)

Source: For the special researchers fund, the Annual Report of the Japan Society for the promotion of Science (FY1985 to 1987); for the Japan Scholarship Founda Foundation (FY1987)

Note: Medicine, dentistry and pharmacology students are not included in scholarship students of the Japan Scholarship Foundation. For details on the Foundation, refer to Table 58.

Of all the students in the graduate schools of Japan, the number who received scholarships in fiscal 1987 and the annual grant amount are shown in Table 40.

In the column on number of scholarship students in the same table, the figures in parenthesis give the compositional per centage when it is assumed that a scholarship grant cannot be received in duplicate. Hence if there are students who receive scholarship funds more than once, the percentage of students who do not receive such funds (self-support) exceeds the rate of 59 percent by an increment equivalent to the number of the aforementioned students.

Table 40. Scholarship Students and Grant Amounts by Principal Enterprise Providing Funds (Graduate Schools)

	Number of scholarship students		Annual grant sum	Sum per person
Total number of students enrolled	{78914}			
Regional public bodies	190	(0)	100,320,000 yen	530,000 yen
Schools	3118	(4)	1,311,970,000	420,000
Public corporations	2756	(3)	1,553,020,000	560,000
Commercial enterprises	505	(1)	325,390,000	640,000
Individuals, other	75	(0)	26,200,000	350,000
Subtotal	6644	(8)	3,316,900,000	500,000
Japan Scholarship Foundation	25772	(33)		masters 830,000 doctors 960,000
Self-support	46498	(59)		

Source: "Fact-finding Survey of Scholarship Grants" by the Ministry of Education, Science and Culture, 1988 edition

Note: Among the figures in parenthesis in the column for scholarship students,the percentage of scholarship students among all enrolled students and the percentage in the self-support column were calculated on the assumption that there is no overlapping of grant provision from other major enterprises.

In the case of institutions granting the doctorate in sciencesand engineering in the United States, as shown in Table 41, 14 percent of the science students and 32 percent of the engineering students depend upon self-support for their living expenses.

The other students obtain support while studying through fellowship, trainership, research assistantship (given as remuneration for working as a research assistant for a full-time professor; given to encourage research required for obtaining the Ph. D), teaching assistantship (remuneration given to those who intend to become full-time professors in the future and who are

now assisting in instruction duties under the supervision and guidance of a full-time professor), scholarship or teaching fellowship.

Note: According to reference document 16 ("Survey of Graduate Schools and Academic Degree System in America" by Hiromasa Itsumi) the annual remuneration at the beginning of the 1970s was 300 to 3600 US dollars for fellowship and scholarship, 3447 dollars for research assistantship and teaching assistantship and 4158 dollars for teaching fellowship. Fees paid by graduate students at the University of California at the time came to a total of 227 dollars--100 dollars as university registration fee, 120 dollars as instruction fee, and 7 dollars in other fees.
In fiscal 1972, the scholarship sum per student granted by the Japan Scholarship Foundation came to a monthly income of 30,000 yen.

The systems of research assistantship, teaching assistantshipand teaching fellowship are not found in Japan. Of all the science students in the United States, 35 percent have received research assistantships. (For details, refer to reference documents 12, 14 and 16.)

Table 41. Status of Economic Support to Science and Engineering Students at Graduate Schools in the United States

Year	1980		1986	
	Number of students	Compositional percentage	Number of students	Compositional percentage
Science	77704	100	86666	100
Fellowship and traineeship	12341	16	12978	15
Research assistantships	22240	29	27712	32
Teaching assistantships	26950	35	29389	34
Other types of support	4121	5	4849	6
Self-support	12052	15	11738	13
Engineering	47839	100	73429	100
Fellowship and traineeship	4970	11	6674	9
Research assistantships	14951	31	22691	31
Teaching assistantships	8654	18	14082	19
Other types of support	4760	10	6651	9
Self-support	14504	30	23331	32

Source: NSF "science & engineering indicators-1987"
Note: Number of students denotes full-time students. For details, refer to Table 59 of the attached statistics tables.

Another fact which must be considered is that students in the United States include part-time students as well as full-time. Doubtless the system of part-time students contributes economic support to these students. Of all those who obtained master's degrees in 1985 and then continued as students, 20 percent were part-time in the sciences and 32 percent were part-time students in engineering. (See Table 45 of the attached statistics tables.)

(2) Percentage of Those Not Becoming Doctorates

The percentages of doctorate degree acquisitions are as discussed in II, 1 (1) 4) and III, 1 (1) 4) of this report.

In the case of Japan, the percentage who do not obtain the doctorate degree has been steadily diminishing since 1980. Never theless, in 1988 roughly 30 percent of candidates in both science and engineering completed the doctorate program but did not obtain the doctorate degree. (For details, refer to Tables 42 and 43 of the attached statistics tables.)

(3) Employment Trends of Those Who Graduated Science Doctorate Programs.

1) Trend in Employment of Those Who Graduated Science Doctorate Programs

— employment rate at about 50 percent,
unemployment rate around 40 percent —

As shown in Table 43, university professors and research institutions account for the majority of employers of those who complete doctorate programs and received their degrees and chose who did not. The period of each year during which employment for these graduates is determined varies from that for regular college graduates and is not confined to April 1st. "The basic survey on schools" of the Education Ministry, sciences and culture is conducted on May 1st and at that time, employers are still not yet determined. Assuming, however,that employers are determined shortly thereafter in a substantial number of cases, the actual situation may be some what better than that shown in the table.

Table 42. Employment Status of Those Who Completion Science Doctorate Programs.

Year of Completed		1980	1985	1988	1989
Number who completed with doctorate	(1)	325	347	393	
Number of completed without doctorate degrees	(2)	264	263	196	675
Number of employed	(3)	259	287	298	328
Number of unemployed	(4)	309	278	248	256
Employment rate	((3) / (1))	80%	83	76	--
	((3) /{(1)+(2)})	44%	47	51	49
Unemployment rate	((4) /{(1)+(2)})	52%	46	42	38

Source: Compiled by author from "Report of Basic Survey on Schools " Ministry of Education, Science and culture (each year; for 1989, however, values are immediate.)

Note: For details, refer to Tables 42, 52 and 71 of the attached Statistics tables.

From Table 42, it appears on the one hand that the situation has been changing recently, yet it can also be asserted that the employment situation for those who completed science doctorate programs and received their degrees and those who did not. still remains severe as in the past.

Table 43. Employers of Those Who Complete University Science Doctorate Programs and received their degrees and those who did not

Year of completion	Number of employed completes	University instructors	Scientific researchers	Total unidentified
1980	259 (100)	117 (45)	54 (21)	171 (66)
1985	287 (100)	79 (28)	82 (29)	161 (56)
1988	298 (100)	100 (34)	65 (22)	165 (55)
1989	328	unknown	100 (34)	

Source: Compiled by author from "Report of Basic Survey on Schools " Ministry of Education, Science and culture (each year; for 1989, however, values are immediate.

Note: For details, refer to Tables 54 and 71 of the attached Statistics tables.

Table 44. Employment in Manufacturing Industries of Those Who Complete Science Doctorate Programs and received their degrees and those who did not

Year of graduation	Number of employed graduates	Manufacturing industries
1980	259 (100)	61 (24)
1985	287 (100)	98 (34)
1988	298 (100)	71 (24)
1989	328 (100)	83 (25)

Source: "Report of Basic Survey on Schools " Ministry of Education, Science and culture (each year) For 1989, however, values are immediate.

Note: For details, refer to Tables 52, 56 and 71.

Of all the graduates who completed a university science doctorate program, then obtained employment, the percentage who were hired as university professors and scientific researchers (those engaged in specialized, scientific activities in order to solve academic and technological problems basic in nature or pertinent to application and development in any or all departments of natural science, humanities and social sciences at research institutions such as laboratories, testing centers or research centers) had hitherto been slightly higher than among engineering doctorates, but in 1988 it fell to less than 60 percent to become roughly equivalent to the percentage for engineers.

The percentage of those employed in the manufacturing industries was 24 percent in 1988, the same as in 1980 (25 percent in 1989).

2) Trend in Employment of Those Who Graduated University Engineering Doctorate Programs

— employment rate at about 68 percent,
unemployment rate around 20 percent —

Employment conditions of those who completed university engineering doctorate programs are better than in the case of those who completed science doctorate programs. The employment rate of the former graduates is 68% in 1988. Those who remain unemployed among these graduates decreased from 27% in 1980 to 20% in 1988 (and 21% in 1989).

Accordingly, it can be said that the employment conditions of engineering graduates are more stabilized than in the case of science graduates.

Table 45. Employment Status of Those Who Complete Engineering Doctorate Programs

Year of completion		1980	1985	1988	1989
Number who completed with doctorate degree	(1)	369	358	519	
Number of completed without doctorate degree	(2)	288	194	202	915
Number of employed	(3)	434	411	492	624
Number of unemployed	(4)	175	114	141	194
Employment rate ((3) / (1)) ((3)/{(1)+(2)})		66%	74	95% 68	68
Unemployment rate ((4)/{(1)+(2)})		27%	21	20	21

Source: Compiled by author from "Report of Basic Survey on Schools " Ministry of Education, Science and culture (each year) For 1989, however, values are immediate.
Note: For details, refer to Tables 53 and 71 of the attached Statistics tables.

Of all those who complete engineering doctorate programs, the percentage who are hired as university instructors or scientific researchers has hovered at around 50 percent since 1980.

Table 46. Employers of Those Who Complete University Engineering Doctorate Programs and received their degrees and those who did not

Year of completion	Number of employed, completes	University instructors	Scientific researchers	Total unidentified
1980	434 (100)	165 (38)	63 (15)	228 (53)
1985	411 (100)	143 (35)	50 (12)	193 (47)
1988	492 (100)	204 (41)	52 (11)	256 (52)
1989	624 (100)	unknown	96 (15)	

Source: Compiled by author from "Report of Basic Survey on Schools " Ministry of Education, Science and culture (each year; for 1989, however, values are immediate.)
Note: For details, refer to Tables 55 and 71 of the attached Statistics tables.

The percentage of completes who find employment in the manufacturing industries dropped from 40 percent in 1980 to 28 percent in 1988 (33 percent in 1989).

Table 47. Employment in Manufacturing Industries of Those who Complete Engineering Doctorate Programs and received their degrees and those who did not

Year of completion	Number of employed completion	Manufacturing industries
1980	434 (100)	174 (40)
1985	411 (100)	139 (34)
1988	492 (100)	138 (28)
1989	624 (100)	207 (33)

Source: "Report of Basic Survey on Schools " Ministry of Education, Science and culture (each year) For 1989, however, values are immediate.
Note: For details, refer to Tables 53 , 57 and 71 of the attached Statistics tables.

(4) Research Environment of University Research Institutes and of Private Research Institutes

Whether or not students at a university advance to its doctorate programs in science or engineering is one indication of theuality of the university's research facilities.

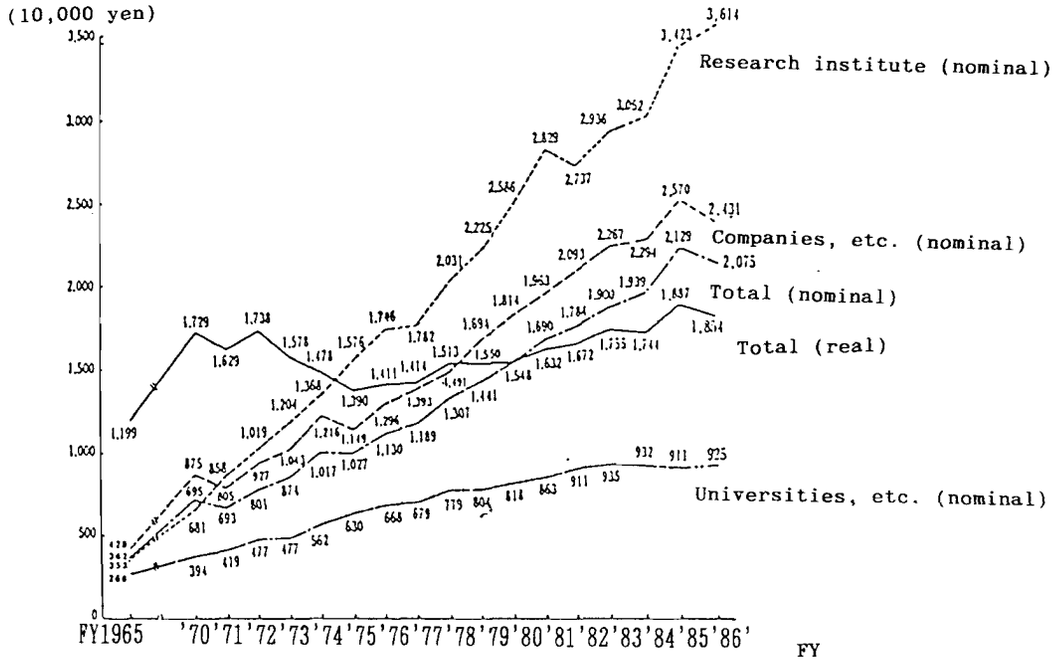
Concerning the research environment of university research institutes and private research institutes in Japan, in a comparison by research expense per individual researcher (each item) from fiscal 1970 to 1986, we find that whereas the cost of university research institutes increased from 3,940,000 to 9,250,000 yen, that of private institutes rose from 8,750,000 to 24,310,000 yen. Looking at these figures alone, the gap in financial outlays by the two categories of research institute widened from about five to fifteen million yen. (White Paper on Science and Technology , 1988 edition)

Given such conditions, it is not unreasonable for students to conclude that a better environment for research can obtained by joining a private institute than by staying at the university under its doctorate programs.

In recent years the number of engineering doctorates who obtaintheir degrees by dissertation has exceeded 60 percent of the total, and one of the factors behind this trend has been the assumption on the part of students that facilities at private

research institutes are more abundant and complete. (For trend in number of dissertation doctorates in engineering, refer to Table 7 of the attached statistics tables.)

Figure 18. Trend in Research Expense Per Individual Researcher in Japan



Note: Research expense per individual researcher is obtained by taking the total outlay for research by the institute in the fiscal year and dividing it by the number of researchers at the institution on the first day of the fiscal year, that is, April 1st. For the total (real), fiscal 1980 is taken as the standard.

Source: "White Paper on Science and Technology," Science and Technology Agency, 1988 edition

2 Graduated Doctorates Programs as Viewed by Corporations

— severe rate of unemployment —

In view of the fact that the unemployment rate for science-masters was 5 percent in 1988 (4 percent in 1989) (see Table 10) and for engineering masters, 2 percent (1 percent in 1989) (see Table 24), employment conditions for those who completed master's programs in 1988 can be considered highly favorable.

Looking at the employment conditions for completed doctorates programs and received their degrees and those who did not . however, we find a complete turnabout for the worse, although some signs of improvement can be noted.

Among completed doctorate programs and received their degrees and those who did not in science, the rate of unemployment

reached 42 percent in 1988 (38 percent in 1989). For completed doctorate programs and received their degrees and those who did not in engineering,the rate was 20 percent (21 percent in 1989), as shown in Table 45. As already noted, those who complete doctorate programs are not so attractive to corporations in Japan.

When those who have completed the master's programs, and thosewho have completed a doctorate programs and received their degrees and those who did not, are added to those who have graduated from a department and then obtained employment in a manufacturing industry, the compositional percentages are as shown in Tables 48 and 49. These tables indicate that whereas the percentage of those who completed the master's programs and then found employment in a manufacturing industry increased greatly over the past ten years, the percentage of those who completed a doctorate programs and received their degrees and those who did not has remained depressed.

This fact makes it all the more clear that the manufacturing industries put greater emphasis on those who complete a master's programs at a graduate school.

Table 48. Compositional Percentages by Academic History of University Science Graduates Employed in the Manufacturing Industries

Year	Department graduates (%)	Master's Programs Graduated (%)	Doctorate Programs Graduated (%)
1970	90	9	1
1975	87	11	2
1980	81	17	2
1985	80	18	2
1988	76	22	2
1989	71	26	2

Source: " Report of Basic Survey on Schools " Ministry of Education, Science and culture (each year) For 1989, however, values are immediate.

Note: For details, refer to Tables 56 and 71 of the attached Statistics tables.

Table 49. Compositional Percentages by Academic History of University Engineering Graduates Employed in the Manufacturing Industries

Year	Department graduates (%)	Master's programs completed (%)	Doctorate programs completed (%)
1970	93	7	0
1975	88	11	1
1980	87	12	1
1985	86	14	0
1988	83	17	0
1989	81	18	1

Source: " Report of Basic Survey on Schools " Ministry of Education, Science and culture (each year) For 1989, however, values are immediate.
Note: For details, refer to Tables 57 and 71 of the attached Statistics tables.

In an interview survey conducted by the National Institute of Science and Technology Policy Science and Technology Agency on those in charge of employment personnel for corporations in the manufacturing industries, the majority answered that completed of university master's degree programs were considered essential personnel for R&D in manufacturing and this outlook was reflected in the employment statistics. Even university professors in charge make the same observation. (For details, see reference document 50.)

Among those in charge of research organs of corporations, it was generally maintained that those who complete a university doc torate programs tend to adhere to their fields of specialization without demonstrating much flexibility. It appears that this is one of main reasons why corporations are especially cautious in hiring those who complete a doctorate programs.

Another reason why employment of those who completed doctorate programs and received their degrees and those who did not has been stagnant is the fact that even though R&D institutions, centering on national institutes, want to hire young researchers, it is extremely difficult to hire young people because of factors such as a limited number of personnel allocated to the particular institutes.

As shown in Tables 43 and 46, the majority of those who completed doctorate programs and received their degrees and those who did not are employed as university professors or scientific researchers.

At this point, let us look at the breakdown by age of instructions at the national universities as shown in Table 50.

In comparing the age composition in 1965 and 1988, the percentage in the age category of under 36 years old dropped from 38 percent to 23 percent while the percentage in the age category of 36 to under 60 years old climbed from 62 to 77 percent. Looking at the age composition of personnel at the laboratories of the national testing and research centers during the same period, the percentage of the age category of under 36 years old fell sharply while the category from 48 to under 60 years old jumped by a wide margin.

Table 50. Trend in Age Composition at National Universities and Research Institutions

Year	Age composition of national university instructors			Age composition of national testers and researchers		
	~36 years old	36 - 48	48 - 60	~36 years old	36 - 48	48 - 60
1965	38%	34%	28%	51%	38%	11%
1980	30	40	30	30	36	34
1988	23	43	34	28	40	32

Source: "Fact-finding Survey of Pay Rates in government sector" by the National Personnel Authority (each year)

Note: For details, refer to Table 60 of attached statistics tables.

Shown in Tables 51 and 52 are the age compositions of university department graduates and of those who completed a graduate school program who worked in all industries as specialist technicians from 1982 to 1987.

According to these tables, the percentage of those under 35 years of age in 1987 stood at 45 percent.

In the age composition of university department graduates and of those who completed the master's programs who are working in the manufacturing industries, the percentage of those under 35 years of age in 1987 stood at 44 percent.

Table 51. Trend in Age Composition of University Department Graduates and of Those Who Complete Graduate School Program Who are Employed as Specialist Technicians (All Industries)

Year	~24 years old	25 - 34	35 - 44	45 - 54	55 -
1982	8%	41%	25%	18%	8%
1987	7	38	28	16	11

Source: " Employment states Survey Report " Statistics, Bureau Management and Coordination Agency,(1982 and 1987)
Note: For details, refer of Table 61 statistics tables.

Table 52. Trend in Age Composition of University Department Graduates and of Those Who Complete Graduate School Program Who are Employed in Manufacturing Industries

Year	~24 years old	25 - 34	35 - 44	45 - 54	55 -
1982	9%	40%	30%	16%	5%
1987	8	36	30	19	7

Source: " Employment states Survey Report," Statistics, Bureau Management and Coordination Agency,(1982 and 1987)
Note: For details, refer of Table 62 statistics tables.

In comparing the age composition of university department graduates and of those who complete a graduate school program for all industries and for the manufacturing industries, it become sevident that age composition of those in the national testing and research centers is characterized by a sharp increase in the age level from 1965 onward.

V Conclusion

V Conclusion

1 Distinguishing Features of Number of Science and Engineering Doctorates in Japan

(1) Summary of Comparison in Number of Doctorates in Japan and the U.S.

The numbers of doctorates produced annually in Japan and in the U.S. out of a total population of 100,000 are as discussed in Sections II and III. The results can be organized here once again as indicated by Tables 53 and 54 below.

1) Numbers of Science Doctorates

The number of science doctorates per unit populationin Japan, with foreign students included, has declined steadily from 1981 (fiscal 1980) to 1988 (fiscal 1987) in terms of the number of course-work doctorates, the total of course-work doctorates and dissertation doctorates, and the number of young doctorates (total of number of course-work doctorates and number of dissertation doctorates not more than 35 years old). In the United States, on the other hand, the number of science doctorates has been increasing.

Accordingly, the sharp gap between Japan and the United States has been widening even further, albeit at a slow pace.

As for the number of doctorates per unit population excluding foreign students, in Japan the figures have been declining for the number of course-work doctorates, the total of course-work doctorates and dissertation doctorates, and the number of young doctorates (total of number of course-work doctorates and number of dissertation doctor ates not more than 35 years old). By contrast, in the United States there has been an equivalent drop so that Japan's percentage with respect to the United States has re mained roughly unchanged.

However, the number of young doctorates in Japan excluding foreign students (total of number of course-work doctorates and number of dissertation doctorates not more than 35 years old) was only 17 percent of the number in the United States in 1988 (fiscal 1987). This fact should be regarded as a major issue for Japan since we want to promote basic research.

Table 53 Comparison of Number of Science Doctorates in Japan and the United States

Year	Total number of doctorates				Total number excluding foreign students, etc.			
	Japan			United States	Japan			United States
	Course	Total of course and disser-tation	Young		Course	Total of course and disser-tation	Young	
1981	0.39	0.70	0.53	3.36	0.39	0.70	0.53	2.84
	(12)	(21)	(16)	(100)	(14)	(25)	(19)	(100)
1988	0.38	0.69	0.48	3.61	0.35	0.66	0.45	2.62
	(11)	(19)	(13)	(100)	(13)	(25)	(17)	(100)

Fig. 19. Comparison of Number of Course-Work Doctorates in Japan and Number of Doctorates in the United States
(Science doctorates)

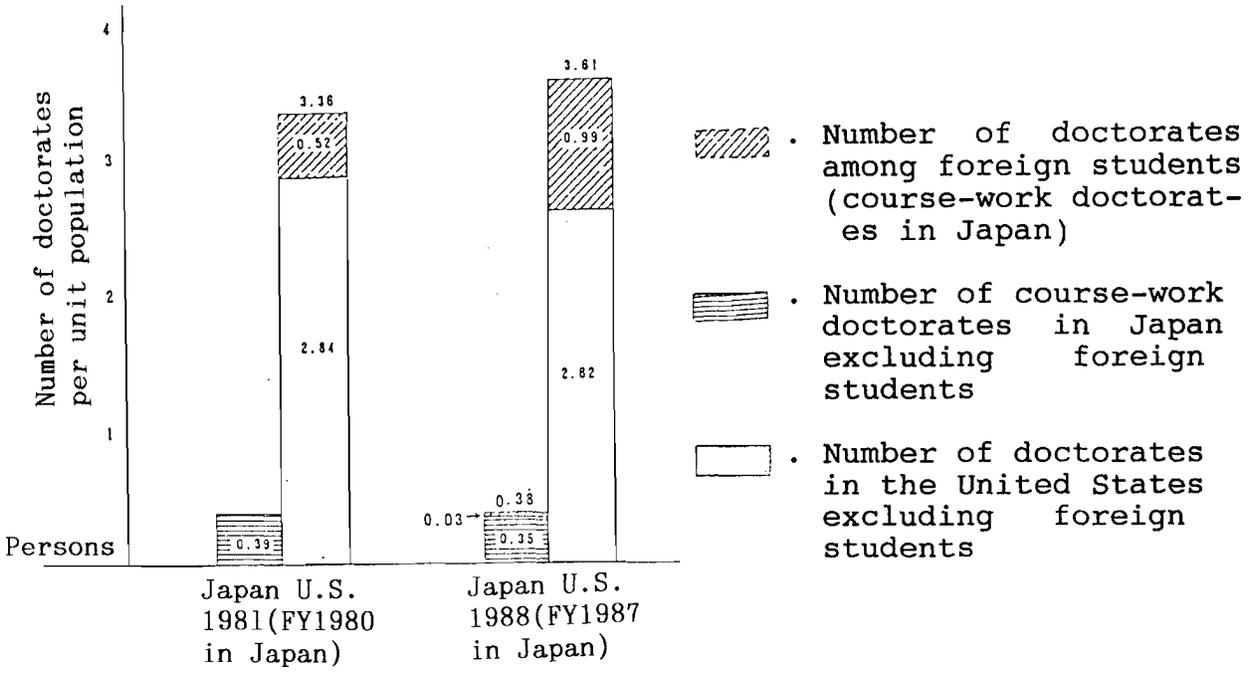
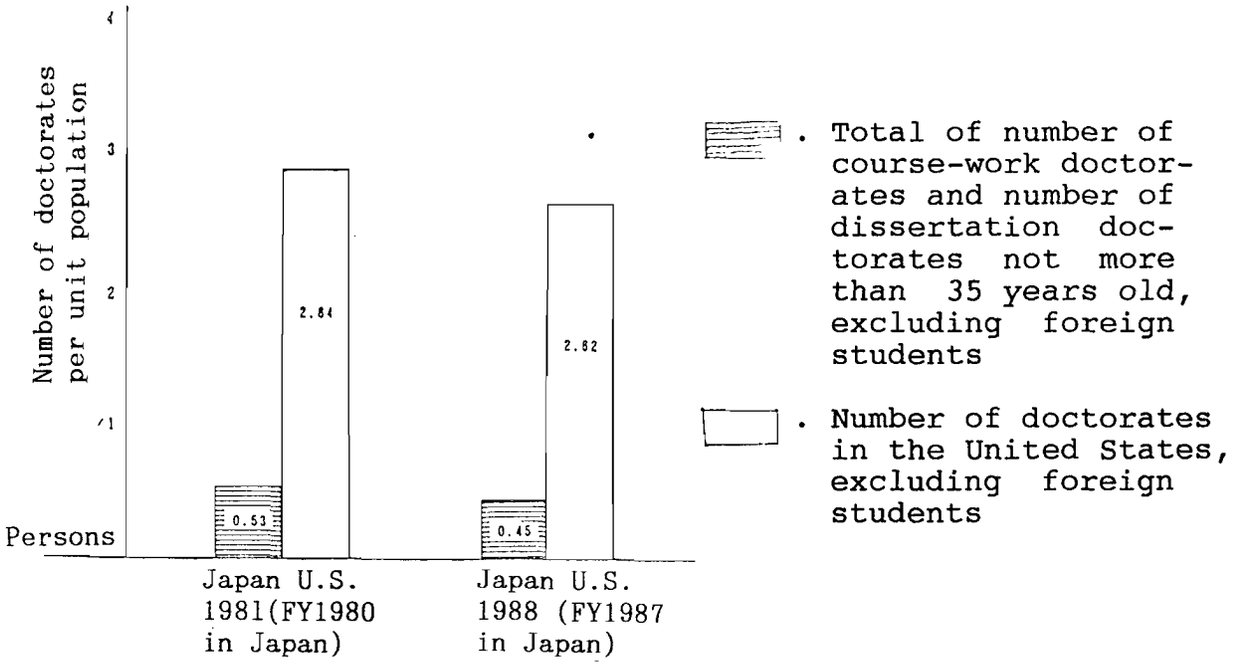


Fig. 20. Comparison of Number of Young Doctorates in Japan (total of number of course-work doctorates and number of dissertation doctorates not more than 35 years old) and Number of Doctorates in the United States
(Science doctorates)



2) Numbers of Engineering Doctorates

The number of engineering doctorates per unit population in Japan, with foreign students included, has increased steadily from 1981 (fiscal 1980) to 1988 (fiscal 1987) in terms of the number of course-work doctorates, the total of course-work doctorates and dissertation doctorates, and the number of young doctorates (total of number of course-work doctorates and number of dissertation doctorates not more than 35 years old). In the United States, on the other hand, the number of doctorates specializing in computer science has risen from 188 to 326, for an increase of 59 percent in the total number of engineering doctorates. As a result, Japan's percentage with respect to the United States has been declining.

With foreign students excluded, there has been a steady increase in Japan in the total of both course-work and dissertation doctorates, but the number of course-work doctors and the number of young doctorates have dropped. By contrast, in the United States the number of engineering doctorates has been increasing since 1981, but the rate of this increase reduces to only 39 percent because the per centage of foreign students is high. As a result, the total of course-work doctorates and dissertation doctorates in Japan in 1988 (fiscal 1987) surpasses the total in the United States. Yet in the same year, the number of course-work doctorates in Japan reached 38 percent of the number in the United States and the number of young doctorates was only 56 percent of the number in the United States.

Until now there have been only a small number of cases in which a comparison was made between Japan and the United States by absolute values of the number of doctorates.

Even if such comparisons have been made, foreign students were included as well as a number of dissertation doctorates who earned their degrees at a late age.

However, by making a comparison in which foreign students are excluded and the subjects are limited to the number of young doctorates (total of number of course-work doctorates and number of dissertation doctorates not more than 35 years old), it was found that the number of engi neering doctorates in Japan in 1988 amounted to 56 percent (1988) of the number in the United States, so that the gap between the two countries is more evident now than seven years ago.

In view of the fact that the number of foreign students in Japan is increasing, there is considerable danger that this phenomenon will spread further in the future. And this poses as a major issue for Japan in its attempt to promote science and technology.

Table 54 Comparison of Number of Engineering Doctorates in Japan and the United States

Year	Total number of doctorates				Total number excluding foreign students, etc.			
	Japan			United States	Japan			United States
	Course	Total of course-work and dissertation	Young		Course	Total of course-work and dissertation	Young	
1981	0.45	1.01	0.61	1.20	0.43	0.99	0.59	0.72
	(38)	(84)	(51)	(100)	(60)	(138)	(82)	(100)
1988	0.51	1.27	0.69	1.91	0.38	1.13	0.56	1.00
	(27)	(66)	(36)	(100)	(38)	(113)	(56)	(100)

Fig. 21 Comparison of Number of Course-Work Doctorates in Japan and Number of Doctorates in the United States
(Engineering Doctorates)

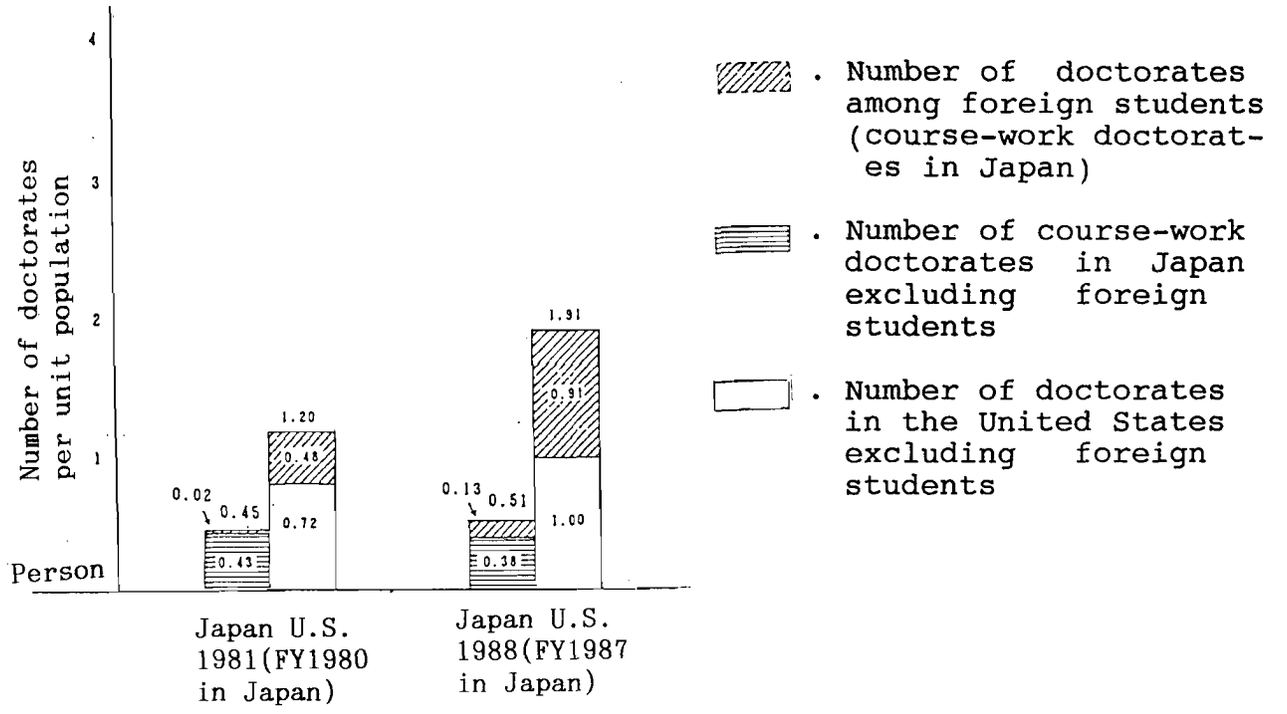
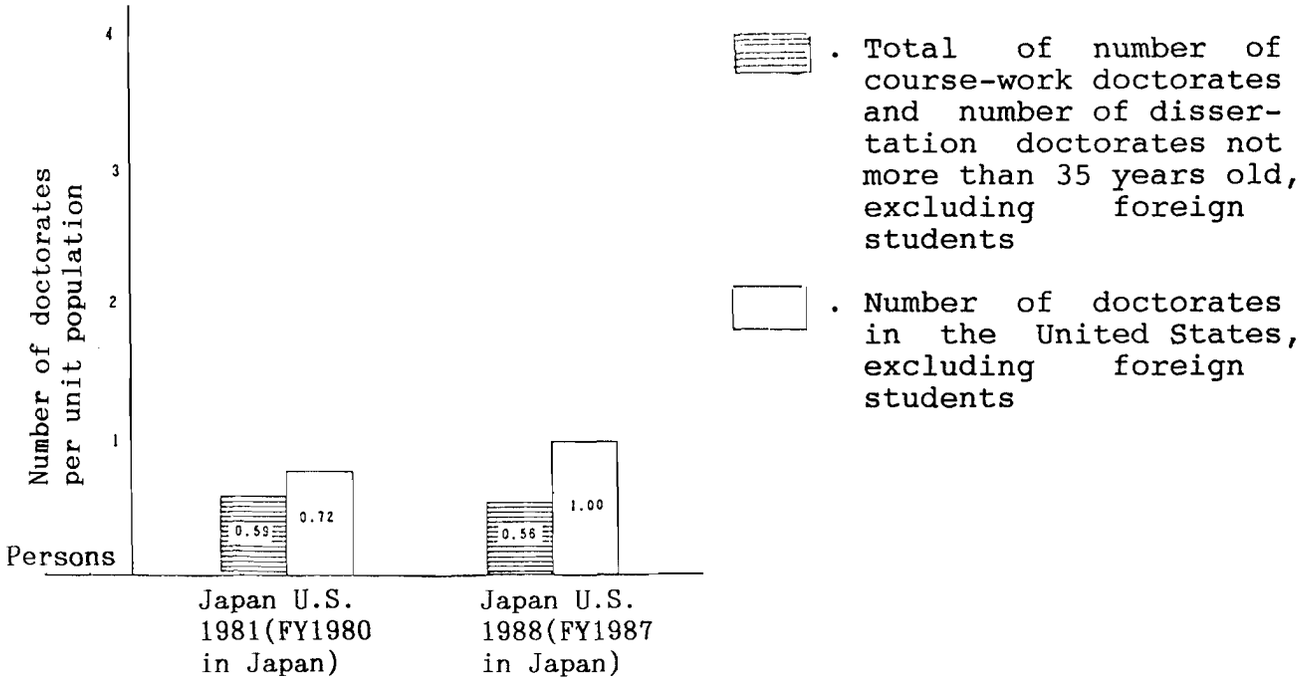


Fig. 22 Comparison of Number of Young Doctorates in Japan (total of number of course-work doctorates and number of dissertation doctorates not more than 35 years old) and Number of Doctorates in the United States
(Engineering Doctorates)



(2) Comparison of Number of Doctorates in Other Leading Nations

Table 55 Comparison of Number of Science and Engineering Doctorates in Leading Nations

Year	Japan	
	Engineering	Science
1970	853	610
1975	986	676
1980	1186	822
1985	1404 (163)	860 (100)

Year	United States		West Germany		England	
	Engineering	Science	Engineering	Science	Engineering	Science
1970	3434	8989	768	1955	(2755)	(4102)
1975	3002	8354	917	2307	(3037)	(4259)
1980	2697	7696	920	2363	(3691)	(5028)
1985	3476 (43)	8012 (100)	1020 (35)	2894 (100)	(3900) (70)	(5600) (100)

Source: For Japan, data were compiled by the authors from "University Data Resources" edited by the Ministry of Education, Science and Culture and for the United States, from data resources of the National Science Foundation (reference document 41). For England, data was obtained from "International Comparison of Education Indexes" from 1978 to 1987 by the Ministry of Education, Sciences and Culture.

Note: Values for England include both holders of master's degrees and holders of doctorate degrees. Of the number of doctorates in 1975, 2,263 were in science and 1,005 were in engineering. The year for Japan means fiscal year.

In comparing the number of science and engineering doctorates inJapan with those in other leading nations, we find that

Japan is unique in having a small number of science doctorates, as shown in Table 55, and a large number of engineering doctorates.

(3) Development of Science and Technology in Japan and Transformation in Number of Science Doctorates and Number of Engineering Doctorates

In looking back over the history of the development of science and technology in Japan, we note that after "the Meiji Restoration", attention was focussed primarily on transferring to Japan the science and technology of Europe and the United States. In particular, at the time of Japan's defect in World War II in 1945, emphasis was concentrated on restoring the nation by building up its industrial productive capacity so greatest importance was placed upon rearing graduates from engineering departments rather than from the science departments. This tendency is made evident in Table 56.

It indicates that in Japan, emphasis has always been put upon cultivating human resources directly connected with the production of actual products or the development of these products rather than on human resources for basic research.

Table 56 Trend in Numbers of University Graduates from Science Departments and from Engineering Departments

Year	All departments		Science departments		Engineering departments	
1926 (Showa-1)	7094	(100)	223	(100)	778	(100)
1930	10991	(155)	245	(110)	918	(118)
1935	12781	(180)	347	(156)	1380	(177)
1940	13258	(187)	351	(157)	1636	(210)
1945	9633	(136)	453	(203)	2969	(382)
1950	21624	(305)	1241	(557)	3989	(513)
1955	85773	(1209)	2487	(1115)	11499	(1478)
1960	119809	(1689)	3184	(1428)	16312	(2097)
1965	162349	(2289)	4748	(2129)	30121	(3872)
1970	240921	(3396)	7209	(3233)	48481	(6231)
1975	313072	(4413)	9504	(4262)	65422	(8409)
1980	378666	(5338)	11554	(5181)	73508	(9448)
1985	373302	(5262)	12698	(5694)	71396	(9177)
1989	376688	(5310)	13295	(5962)	75678	(9727)

Source: For data from 1926 to 1955, "Universities and Employment" by the Ministry of Education, Science and Culture. Thereafter, from "Report of Basic Survey on Schools" by the Ministry of Education Science and Culture. (Data was taken for each year. for 1989 However, values are immediate.)

The tendency toward emphasis on engineering department can also be seen, as shown in the next table, among those who completed the training courses for the master's degree.

Table 57 Trend Among Those Who Completed Master's Programs

Year	Science		Engineering	
1960	536	(100)	539	(100)
1965	786	(147)	1666	(309)
1970	1302	(243)	3891	(722)
1975	1382	(258)	6060	(1124)
1980	1649	(308)	7135	(1324)
1985	1992	(372)	6828	(1601)
1989	2598	(485)	11915	(2211)

Source: "Report of Basic Survey on Schools" by the Ministry of Education, Science and Culture (Data was taken for each year. For 1960, however, those who were studying in the second year of the doctorate programs in FY 1959 were regarded as having completed the master's programs. for 1989, However Values are immediate.)

When the number of master's degree holders in science is taken as 100, the number of master's degree holders in engineering is 433 in Japan, as shown in Table 58, and 187 in the United States.

Here, computer sciences is included under engineering, but if it were not included, the gap between Japan and the United States would be much wider.

Table 58 Comparison of the Number of Master's Degree Holders in Science and Engineering in Japan and the United States

	Japan		United States	
	Engineering	Science	Engineering	Science
1985	8628	1992	29600	15800
	(433)	(100)	(187)	(100)
Case in which computer sciences is not included under engineering in the United States			19900	25500
			(78)	(100)

Source: For Japan, " Report of Basic Survey on Schools " by the Ministry of Education, Science and Culture For the United States, "Characteristics of Recent Science / Engineering Graduates: 1988 " by the National Science Foundation.

Let us look at the trend in the number of engineering doctorates in Japan as opposed to the number of science doctorates.

From 1887 to 1962, the number of candidates awarded the doctorate degree in science, according to the terms of the former law on academic Degree Ordinance, stood at 5,830 and the number of engineering doctorates stood at 6,715. If the number of science doctorates is taken as 100, the number of engineering doctorates comes to 115. Thus there is no great disparity between the number of science doctorates and the number of engineering doctorates. (For more details, see Table 1 of the attached statistics tables .)

Looking at the number of doctorates by the terms of the presentlaw, we find that the number of science doctorates from fiscal 1957 to fiscal 1964 surpassed the number of engineering doctorates, but that from fiscal 1965, the number of engineering doctorates exceeds the number of science doctorates.

Then in fiscal 1987, after a period of 30 years, the number of science doctorates stood at 837, or five times the number in fiscal 1960, and the number of engineering doctorates came to 1547, or 20 times the number in 1960. Thus if the number of science doctorates is taken as 100, the number of engineering doctorates amounts to 185.

The fact that historically, emphasis has always been put on engineering is thus reflected also in the numbers of doctorates in Japan.

Table 59 Trend in Number of Doctorates

Fiscal year	Number of science doctorates		Number of engineering doctorates	
1960	162	(100)	78	(100)
1965	416	(257)	419	(537)
1970	610	(377)	853	(1094)
1975	676	(417)	986	(1264)
1980	822	(507)	1186	(1521)
1985	860	(531)	1404	(1800)
1987	837	(517)	1547	(1983)

Source: Compiled by the authors from " University Data Resources" by the Ministry of Education, Science and Culture (each number from 10 to 33 in reference documents)

Note: For details, refer to Tables No.3 and 7 of the attached statistics tables.

Furthermore, in the United States more than half the number of science doctorates are majors in biology.

The major factor behind the increase in the number of engineering doctorates and master's degree holders from 1980 to 1985 was the increase in computer science.

These facts are important for considering the number of doctorates in Japan, so the trends in the numbers of each of the aforementioned categories of specialists is given below.

Table 60 Trends in the Number of Specialists in Biology and Computer Science in the United States

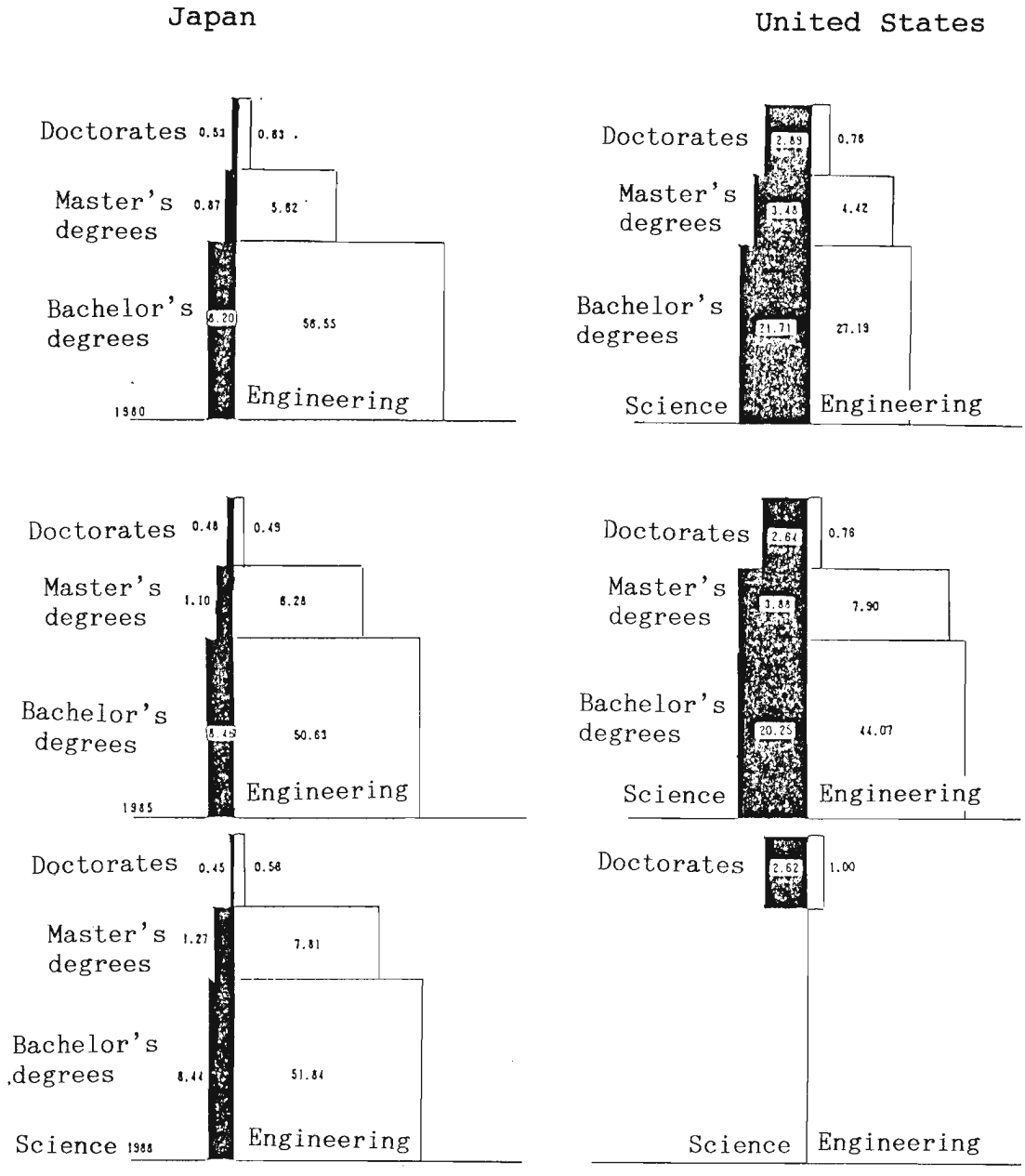
Year	Biology			Computer science		
	Number of bachelor's degrees	Number of master's degrees	Number of doctorates	Number of bachelor's degrees	Number of master's degrees	Number of doctorates
1980	24900	3400	3430	9800	2600	169
1985	19600	3100	3252	35900	6800	213
1988			3310			326

Source: Compiled by authors from NSF resources (reference documents 37)

Note: The numbers in each category include U.S. citizens and non-U.S. citizens with permanent visas. The numbers of bachelor's and master's degrees are round numbers. For details, refer to Tables No.47 and 65 of the attached statistics tables.

The supply structure of human resources in science and technology in Japan, that is to say, the number of graduates (exclusive of those who progress to advanced study) from engineering and/or science departments who are not foreign students, the number who complete the master's programs. (exclusive of those who progress to advanced study), and the number of young doctorates (total of course doctorates and those not more than 35 years old), was compared with the same in the United States as shown in Fig. 23. In the United States, however, students who progress to more advanced study were regarded as full-time students.

Fig. 23 Comparison of Science and Engineering Human Resources Supply Structure in Japan and the United States



Note: Numerical values represent number of persons per unit population (100,000 people). Foreign students are not included. The number of Japanese doctorates per unit population is equivalent to the number of young doctorates, with 1980 representing fiscal 1979, 1985 representing fiscal 1984 and 1988 representing fiscal 1987. For computation method, source, etc., refer to Table 65 of the attached statistics tables .

As a result of the buildup of the structure for supplying human resources in science and technology, the manufacturing industry in Japan has achieved dramatic growth unprecedented throughout the world.

2 New Functions Fulfilled by the Dissertation Doctoral System

As mentioned previously, the dissertation doctorate system has been continued up to the present while adapting itself flexibly to the demands of each generation.

In order to expand business operations in line with the increasing sophistication of science and technology throughout the world today, private corporations, as made evident by the costs of R&D per researcher shown in Fig. 18, are moving to increase investments in R&D, to bolster their R&D institutions, to secure the very latest equipment together with outstanding personnel, and to direct all their resources into developing technology directly linked with current manufacturing sites.

As a result, the research organs of private corporations fulfillthe role of cultivating researchers in fields of specialization are required for expanding the corporation's scope of business operations. In contrast to conditions in 1945, this new aggressive function has now begun to capture attention even in the United States.

This means that when it becomes necessary for Japanese corporations to cultivate researchers in academic domains unique to the particular enterprise, they can hire students who have completed the master's degree program and educate them so that they can obtain the doctorate degree; in this way, Japanese corporations can elevate the level of their staff resources to international standards.

The dissertation doctorate system has come to be looked upon asa means of research exchange between universities and other research organs through the medium of young researchers who hope to acquire the doctorate degree by dissertation writing, and thus also as a means of generating new advances.

Most of the private research institutions, of course, conduct R&D primarily for the development of products along the lines of their respective parent companies. Given this essential characteristic, these institutions must limit themselves to certain areas of R&D; they often cannot pursue research independently like the graduate schools. This pattern is especially predominant in the realm of basic research. Moreover, the average age at which dissertation doctorates are acquired has been rising, and this is directly related to the issue that the number of young dissertation doctorates has been declining rapidly.

In consideration of this point, the dissertation doctorate system is expected to provide a great driving force behind the promotion of science and technology in Japan because it is established as a means other then the course doctorate programs of obtaining a doctorate degree and because Japan has not introduced

a part-time student system.

The dissertation doctorate system of today has thus begun to take on a new function in contrast to its traditional role, and we have entered an era in which its new role will be evaluated positively.

3 Relationship Between Basic Research and Fields of Specialization in Science by Doctorates

In recent years, growing numbers of facilities for basic research have been established at Japanese private corporations and elsewhere, as shown in the next table.

Basic research is used as the generic term, of course, but it encompasses a wide variety of specific themes, each different from the others, and they cannot be considered collectively.

Nevertheless, the number of research institutions which call themselves centers of basic research has been increasing, and this fact is one indication that among corporations, emphasis has come to be placed upon basic research. In addition, there are institutes which conduct basic research even though they call themselves life science research laboratories, and other institutes which divide their activities between basic research and applied R&D even though they call themselves fiber technology laboratories. Hence the numbers of institutes which are believed to be aimed at basic research even though they do no call themselves as such have been enclosed in parenthesis.

To be sure, private corporations must maintain world standards of technology, and they must lead the world in pioneering new frontiers of R&D. In order to secure a position of relative superiority in the arena of technological competition, they must orient the privvate research institutes toward investigative research. if a corporation has abundant capital resources, it can adopt a long-term perspective and invest large amounts for research activities which have no evident link whatsoever with its current lineup of products.

In Japan, the reason that research organs of private enterprisesare directing more and more of their resources into basic research is that conditions as described above have evolved in the country to the extent that they make such research absolutely necessary.

The way in which conditions have been changing in Japan will mean that demand for talented human resources in basic research will become even stronger among corporate research institutes in the future.

Accordingly, steps must be taken now to secure outstanding human resources for basic research so that the demands of the future can be amply met.

Table 61 Establishment of Basic Research Centers

Category	Foodstuffs and Bio-technology	Chemicals and Pharma-ceuticals	Electronic and information	Other	Total
1962				1	1
1963				(1)	(1)
1971		(1)			(1)
1976	1				1
1980		1	1		2
1981	1				1
1982			1		1
1983	(1)	1	(1)	(1)	1 (3)
1984	(1)	(3)	3		3 (4)
1985	(1)	1	2 (1)	1	4 (2)
1986		2	1	1 (1)	4 (1)
1987	2	4	1 (1)	1 (2)	8 (3)
1988	1	(1)	1	1 (3)	3 (4)
1989		1	1		2
Total	5 (3)	10 (5)	11 (3)	5 (8)	31 (19)

Note: (1) The following types of centers are regarded as basic research centers: basic research center, high-molecular basic research center, investigative research center , semiconductor basic research organ of basic technology research center, research institute, frontier technology research center.
(2) The classification is according to corporation bearing operating expenses. Foundations are taken as other.

The next question is what are the fields of specialization adopted by those who become involved in basic research.

It has already been pointed out that the number of science graduates, exclusive of foreign students, per unit population in the United States, where steady progress is reportedly being made in basic research, is six times greater than the number of young doctorates in Japan.

Of these science doctorates, 52% were biology majors in

1980, asshown in Table No. 47 of the attached statistics tables, and 51 percent were biology majors in 1988. In view of the fact that biotechnology originated and developed in the United States, this pattern clearly demonstrates that there is a close relationship between basic research and those researchers who specialize in scientific fields.

In Japan, looking at the institutions used jointly by the national universities, which all call themselves basic research institutes, we find, as shown in Table 62, that most of their researchers have doctorates and that by field of specialization, there are more science doctorates than engineering doctorates, except in the aerospace research centers.

Table 62 Breakdown of Researchers at Institutes Used Jointly by the National Universities

	Science	Engineering	Medicine	Agriculture	Ph.D	Pharmaceuticals	Other	Total
Composition percentage of gross total	425 (70)	102 (17)	37 (6)	19 (3)	12 (2)	10 (1)	6 (1)	611 (100)
High Energy	217	36	1	0	0	1	1	256
Polar Research	23	2	0	2	0	0	2	29
Space Research	34	41	0	0	2	1	0	78

Source: Kojyun-sha " Record of University Instructors Nationwide, National and Public University Edition."

Note: The Japanese Literature Documents Research Center and the International Japan Culture Research Center are not included in the gross total numbers. "High Energy " is an abridgement of " National Laboratory for High Energy Physics ; " " Polar Research" is an abridgement of "National Institute of Polar Research ; " and " Space Research " is an abridgement of "The Institute of Space and Astronautical Science ." Figures in parenthesis are compositional percentages.

Among private research institutes, the Mitsubishi Kasei Instituteof Life science, in particular, can be regarded as one pursuing basic research, and the types of doctorates at this Institute are shown in the following table. It indicates that doctorates specializing in various fields are required at the Center and that more science doctorates are required than engineering doctorates.

Table 63 Breakdown of Researchers at Mitsubishi Kasei Institute of Life Science Research

	Science	Agriculture	Pharmacology	Medicine	Engineering	Veterinary Science	Fisheries	D.sc	Ph.D
Compositional	43	18	9	9	1	1	1	1	1
percentage of total number	(55)	(16)	(12)	(12)	(1)	(1)	(1)	(1)	(1)

Source: Provision of Mitsubishi Kasei Institute of Life Science Research .

Note: About 20 post-doctoral fellows are not included in the above table. The D.sc is from Italy. Figures in parenthesis are compositional percentages.

Table 63 presents a breakdown of the types of researchers at Hitachi, Ltd. and the percentages of science and engineering doctorates. The closer the particular research center comes to performing basic research, the greater is the number of its science doctorates.

Table 64 Nature of Researchers and Percentage of Science Doctorates at Hitachi, Ltd.

	Number of Doctorate Acquisitions	Breakdown		
		Number of Science Doctorates	Number of Engineering Doctorates	Number of Other Doctorates
Advanced Research Laboratory	34	14 (41%)	18 (53%)	2 (6%)
Central Research Laboratory	193	45 (23)	147 (76)	1 (1)
Other Research Centers	362	52 (14)	308 (85)	2 (1)
Total	589	111 (19)	473 (80)	5 (1)

Source: Provision of Advanced Research Laboratory Hitachi, Ltd.
Note: Figures in parenthesis denote compositional percentage.

This fact indicates that in Japan basic research is related to diverse fields of specialization, but a comparison between doctorates specializing in engineering and those specializing in science reveals that the relationship to basic research is closest among science doctorates.

4 The Expected Cultivation of Researchers in Graduate School Doctorates Programs

The number of young science doctorates (total of course doctorates and dissertation doctorates not more than 35 years old) per unit population in Japan, not including foreign students, is only one-sixth the number in the United States.

In the advanced nations of Europe and America, where basic research is said to be strong, there are many doctorates who have specialized in a science. And in Japan, there appears to be a close relationship between basic research and doctorates specializing in science. In view of these and other related facts, it appears that an increase in the number of doctorates specializing in diverse fields, beginning with the number of doctorates specializing in a science has become absolutely essential for the

promotion of basic research in Japan.

In recent years, there has been a growing number of Japanese corporations, with accumulated capital resources, which have established basic research centers and have taken up basic research projects from a longterm perspective in order to adapt to the elevation of technological standards worldwide and expand the scope of their operations.

However, in view of the fact that the majority of private research centers are pursuing research endeavors which are rooted in corporate objectives, they are very limited in their ability to hire those who have completed master's degree programs and employ them in areas of research which are confined to purely basic research and thereby educate them to become science doctorates.

Consequently, in order to cultivate researchers who have been trained in diverse, yet more basic fields, greater hopes will have to be pinned on the doctorate programs at the nation's graduate schools.

In addition, the situation in Japan regarding the number of engineering doctorates also does not warrant any optimism.

In other words, at the stage where the nation is trying to catch up with the level of science and technology elsewhere, with a composition of human resources centering on bachelor's or master's degree holders, we can expect advancements in the manufacturing industry to be proportionate to the number of graduates from engineering departments.

However, as the level of science and technology becomes highly advanced, as those who earn doctorate degrees obtain more and more opportunities to take part in research endeavors of international scope, as rights to possess knowledge concerning science and technology are transformed, and as other conditions change, the benefits obtained in the past from human resources consisting mainly of bachelor's or master's degree holders can no longer be expected in the future.

Amid the very latest world conditions, the number of young engineering doctorates per unit population in Japan, excluding foreign students, has been declining while the number of the same doctorates in the United States has been increasing. As a result, the number of young engineering doctorates in Japan, excluding foreign students,amounts to only 56 percent of the number in the United States, and with this fact comes the danger that the gap between the two nations will become even wider. This is indeed a major issue for Japan to confront in looking at the course of its development in the future.

The spontaneous increase in the number of dissertation doctorates in engineering in Japan has arisen from the need for the same among Japanese corporations, and it indicates that research institutions other than universities can be relied upon to educate and train engineering doctorates. Yet as greater expectations come to be placed on private institutions for fulfilling this new role of rearing dissertation doctorates, the age level at which candidates acquire the doctorate degree by thesis writing continues to climb, and this has had a significant impact on the stagnation in the growth of the number of young doctorates.

Consequently, the role of graduate school training programs in cultivating researchers will take on increasing importance also for engineering doctorates.

In consideration of the aforementioned, in order to substantially expand the scope of science and technology in Japan and elevate the levels there of, it will be necessary to increase the number of young doctors, in both science and engineering fields, through the graduate school training programs covering diverse fields of specialization so that these doctorates will be able to function independently as researchers, will have advanced research capabilities as required for performing other high-level specialized duties, and will have an abundance of academic knowledge upon which their capabilities are based.

What must be considered to achieve such an objective ?

It was pointed out previously that in a survey conducted by National Institute of Science and Technology Policy, the Science and Technology Agency (reference document 50) university professors gave three majors reasons why students do not advance to the doctorate course: 1) economic limitations; 2) university research facilities are inferior to those of private research institutes; and 3) there is no guarantee that a degree can be obtained within three years.

In Japan, the percentage of all students who must depend upon their own economic resources to cover the costs of living while attending graduate school comes to 59 percent; in the United States, on the other hand, the percentages are 13 percent for science students and 32 percent for engineering students.

Meanwhile, the percentages of students who obtain employment has been turning more favorable, yet about 40 percent of science students and 20 percent of engineering students are unemployed, and the opportunities for such students to obtain employment as university instructors or researchers have not been expanding.

These diverse environmental conditions have acted to curtail or reduce the percentage of students who progress to the doctorate course after completing the master's degree programs, and those who have enrolled at universities are not utilized to the fullest.

In order to promote research and development in Japan, therefore,it has become paramount that the university doctorate programs be made into adequately attractive educational institutions so that large numbers of outstanding students will be drawn to them, and that the research environments at these institutions be augmented so that competent researchers can be trained as they are made to compete with each other in research endeavors.

For this purpose, various types of economic support systems must be augmented. The assistantship system of the United States, for example, could be introduced, and other vital steps could be taken to ensure economic independence for students currently enrolled in doctorate training courses at the nation's graduate schools. At the same time, it has also become urgently necessary to provide employment opportunities suitable for doctorate degree holders; special measures, for example, should be taken to introduce young members, especially researchers and instructors, at national research centers and/or national universities.

Ⅵ Attached Documents

VI Attached Documents

1 Reference Bibliography

1 Kyoiku Gyosei Kenkyujo
"Record of Doctorates in Japan" (1956 edition)

2 Teikoku Chiho Gyosei Gakkai
"Record of Doctorates in Japan" (FY1957 to FY1961)

3 Post-war Education Materials Data Collection Committee Edition

"General Record of Post-war Education Materials" (July 1965)

-1 Concerning the System of Conferring doctorate for the thesis submitted (Draft)
(No. 8 Special Committee of the University Establishment Deliberation Council 1950)

-2 "dissertation Doctorate"
(Addressed to No. 8 Special Committee of the University Establishment Deliberation Council from the Civilian Information Bureau of the General Headquarters of the Supreme Allied Command)

4 Teikoku Chiho Gyosei Gakkai
"Record of Japanese Doctorates" (FY1965)

5 Kojinsha
"Record of Japanese Doctorates" (FY1970)

6 Resources council Science and Technology Agency
"Survey Report on Qualitative Improvement of Researchers and Full Utilization of Them" (Report No.98)

7 National Institute of Resources, Science and Technology Agency
"Survey on Full Utilization of Human Resources for Research in Leading Fields of Science and Technology"

8 Ministry of Education, Science and Culture
"Report of Basic Survey on schools " (from 1957 to 1988)

9 University Section, University Science Bureau, Ministry of Education, Science and Culture
"University Data Resources" (No. 4 Sept. 1956)
(On academic degrees in Japan, University Section, University Science Bureau)

10 Zaidanhojin (Foundation) The Jinbunkyo kyokai
"University Data Resources" (No. 19 March 1969)

(Compiled by University Section, University Science Bureau, Ministry of Education, Science and Culture)

11 Ibid, No. 26 (Feb. 1968)

12 Ibid, No. 27 (April 1968)
(On the Graduate School System in America, Reiko Tsumura)

13 Ibid, No. 29 (October 1968)
(On the Graduate School System in England, Kunitoshi Mizuno, On the Graduate School System in France, Sada Naito)

14 Ibid, No. 30 (March 1969)
(on the Graduate School System in Leading Nations, Teruhiko Wakana)

15 Ibid, No. 36 & 37 combined

16 Ibid, No. 42 (March 1972)
(Investigation of Graduate School and Academic Degree Systems in America, Hiromasa Itsumi)

17 Ibid, No. 45 (Jan. 1973)

18 Ibid, No. 48 (Nov. 1973)

19 Ibid, No. 52 & 53 combined

20 Ibid, No. 56 (Dec. 1975)

21 Ibid, No. 60 & 61 combined

22 Ibid, No. 62 (March 1977)

23 Ibid, No. 66 (March 1978)

24 Ibid, No. 70 (March 1979)

25 Ibid, No. 74 (March 1980)

26 Ibid, No. 78 (March 1981)

27 Ibid, No. 82 (March 1982)

28 Ibid, No. 86 (March 1983)

29 Ibid, No. 90 (March 1984)

30 Ibid, No. 94 (March 1985)

31 Ibid, No. 98 (May 1986)

32 Ibid, No. 101 (Oct. 1987)

33 Ibid, No. 109 (Sept. 1988)

34 Statistic Bureau Management and Coordination Agency
" Population Estimates" (As of October 1st, each year)

35 Statistics Bureau, Prime Minister's office
" Census Survey " (1980, 1985)

36 Department of International Economic and Social Affairs Statistical office
"monthly bulletin of statistics" (1989.7)

37 NSF
"characteristics of recent science/engineering graduates: 1982, 1984, 1986)"

38 NSF
"U.S. scientists and engineers: 1986"

39 NSF
"science & engineering indicators-1987"

40 NSF
"early release of summary statistics on science and engineering doctorates 1988"

41 NSF
"science and engineering doctorates: 1960-81, 1960-87"

42 Leonard H. Lynn, Henry R. Piehler, Walter P. Zahray
"Engineering Graduates in the United States and Japan: A comparison of Numbers, and an Empirical Study of their Career and Methods of Information Transfer" (December, 1988)

43 The Asia Student Cultural Association
"Foreign Student's Guide to Enrollment in Graduate Schools" (1982 edition)

44 The Asia Student Cultural Association
"Foreign Student's Guide to Enrollment in Graduate Schools" (1985 edition)

45 The Asia Student Cultural Association
"Foreign Student's Guide to Enrollment in Graduate Schools" (1987 edition)

46 The Asia Student Cultural Association
"Foreign Student's Guide to Enrollment in Graduate Schools" (1988 edition)

47 Administrative Inspection Bureau, Management and Coordination Agency
"Report of Results of Administrative Inspection of Matters Pertaining to Policies for Acceptance of Foreign Students and Education of Japanese Boys and Girls Returning to Japan" (June 1988)

48 Foreign Students Section, International Bureau of Science, Ministry of Education, Science and Culture
"Outline of System in Japan for Foreign Students" (July 1989)

49 NSF
"Foreign citizens in U.S. science and engineering: history, status, and outlook"

50 National Institute of Science and Technology Policy, Science and Technology Agency
" Employment Trends of Science and Engineering Graduates " (NISTEP Report No.1)

51 Japan Society for the promotion of Science
"Annual Report, 1987"

52 Japan Scholarship Foundation
"Annual Reports, FY1980-88".

53 Society of Applied Physics Edition
"Applied Physics"
(Physics application for the 21st century, Volume No. 58, No. 4, 1989 Concern About Trend Toward Ceiling in Number of Students Advancing to Doctorate Program, Seijiro Furukawa)

54 Survey Bureau, Ministry of Education, Science and Culture
"Major Points of High School Education in Each Nation, June, 1960"

55 Ryuginsha
"History of Development of the Educational System from the Meiji Era," Vol. No. 5
(From Education History by Education Ministry)

56 Ministry of Education, Science and Culture
"Eighty-Year History of the Educational System"

57 Survey, Statistics and Planning Section ; Secretariat, Minister of Education
"International Comparison of Education Indices" (1978 to 1987 editions)

58 National Personnel Authority
"Fact-finding Survey of pay Rates in goverment sector " (1965 to 1988 editions)

59 Survey Bureau, Ministry of Education, Science and Culture
"Major Points of High School Education in Each Nation"

60 Survey Burelau, Ministry of Education, Science and Culture
"High School Education in Each Nation II"

61 Koojunsha
"Record of University Instructors Nationwide"

62 Ministry of Education, Science and Culture
"Universities and Employment"
(March 1957 MEJ 6152)

63 Bureau of statistics office of the Prime Minister'
"Employment Survey Report, 1982"

65 Ibid, 1987

66 Dai Ichi Hooki
"Universities & Students"
(No. 283; July 1989 issue)
(Outline of Fact-Finding Survey Covering Educational Scholarship Work in 1987, Students Section, Bureau of High School Education, Ministry of Education, Science and Culture)

2. Statistics Table Contents

3. Statistics Tables

Table 1. Trend in Number of Science and Engineering Doctorates Granted Under Old Stipulations

Fiscal year	Number of science doctorates		Number of engineering doctorates	
	A	B	A	B
1887 - 1932	182		387	
1921		3		3
1922		9		10
1923		7		6
1924		15		18
1925		11		15
1926		21		22
1927		35		14
1928		27		22
1929		28		36
1930		36		35
1931		42		33
1932		34		38
1933		39		23
1934		32		38
1935		34		40
1936		43		39
1937		53		41
1938		65		26
1939		66		47
1940		67		48
1941		79		53
1942		98		63
1943		81		71
1944		88		62
1945		118		127
1946		53		40
1947		38		61
1948		60		60
1949		77		86
1950		85		106
1951		96		107
1952		102		97
1953		131		125
1954		122		144
1955		142		149
1956		193		177
1957		219		227
1958		253		237
1959		345		307
1960		438		411
1961		1130		1193
1962 1-3		1033		1871
Total	182	5648	387	6328

Source: Kyoiku Gyousei Kenkyujo, "Record of Japanese Doctorates," 1956 edition.

Note : The unit is individual person.
(A) refers to number of doctorates by academic degree ordinance (ordinance No.13)of 1888 and of 1899 (ordinance No. 344).
(B) refers to number of doctorates by academic ordinance (ordinance No.200) of 1921.

Table 2. Number of Science and Engineering Doctorates Awarded by Old Stipulations Broken Down by Relevant Items

Science doctorates

Fiscal year	Recommendation of Teikoku University Evaluation Committee	Recommendation of Teikoku University President	Recommendation of Doctorate Committee	Course	Dissertation	Unidentified	Total
1888	10						10
1891	16						16
1893	1						1
1894	2						2
1895	3					3	6
1898	1						1
1899		2	5				7
1900				3			3
1901		2					2
1902				2	2	1	5
1903					2	1	3
1904					1	1	2
1905		2				1	3
1906				1	3		4
1907					2	1	3
1908					2	1	3
1909		2			1	1	4
1910		2			4	1	7
1911					6	4	10
1912		3		1	1	1	6
1913		6			4		10
1914		1			3	1	5
1915		1			2	2	5
1916		1		2	8	9	20
1917		1			4	2	7
1918		1			3	4	8
1919		6			2	7	15
1920		1		1	2	9	13
1922					1		1
Total	33	31	5	10	53	50	182

Engineering doctorates

1888	10						10
1891	21						21
1893							0
1894							0
1895							0
1898							0
1899		15	31			1	47
1900							0
1901		4	15			1	20
1902		3				1	4
1903		7					7
1904		2					2
1905						3	3
1906		3					3
1907		3				6	9
1908						2	2
1909		1				1	2
1910		2					2
1911		10				3	13
1912		4				4	8
1913		9				1	10
1914						5	5
1915		2	77			2	81
1916		1				1	2
1917		4				5	9
1918		4				3	7
1919		10	52			11	73
1920		3				23	25
1921						5	5
1922						3	3
1923						2	2
1925						1	1
Total	31	87	175	0	0	84	377

Also 10 foreign students in 1915

Source: Gathered and compiled by author from Kyoiku Gyousei Kenkyujo, " Record of Japanese Doctorates ," 1956 edition.

Note: The unit is individual person.

Table 3. Trend in Number of Science Doctorates and in Percentage of Dissertation Doctorates Among Them (by national, public and private universities)

Fiscal year	Science total				National				Public				Private			
	Course	Dissertation	Total	Rate	Course	Dissertation	Total	Rate	Course	Dissertation	Total	Rate	Course	Dissertation	Total	Rate
1957	47	0	47	0%	47	0	47	0%	0	0	0	0%	0	0	0	0%
1958	117	1	118	1%	117	1	118	1%	0	0	0	0%	0	0	0	0%
1959	145	4	149	3%	143	4	147	3%	2	0	2	0%	0	0	0	0%
1960	139	23	162	14%	128	20	148	16%	11	3	14	21%	0	0	0	0%
1961	173	59	232	25%	165	54	219	33%	6	5	11	45%	2	0	2	0%
1962	137	138	275	50%	133	120	253	47%	3	18	21	86%	1	0	1	0%
1963	160	180	340	53%	157	166	323	51%	3	13	16	81%	0	1	1	100%
1964	164	260	424	61%	150	203	353	58%	11	55	66	83%	3	2	5	40%
1965	159	257	416	62%	152	228	380	60%	2	29	31	94%	5	0	5	0%
1966	182	288	470	61%	173	265	438	61%	3	20	23	87%	6	3	9	33%
1967	201	253	454	56%	191	232	423	55%	6	18	24	75%	4	3	7	43%
1968	240	274	514	53%	223	240	463	52%	9	25	34	74%	8	9	17	53%
1969	265	271	536	51%	245	233	478	49%	9	27	36	75%	11	11	22	50%
1970	323	287	610	47%	301	240	541	44%	9	33	42	79%	13	14	27	52%
1971	348	303	651	47%	323	267	590	45%	6	25	31	81%	19	11	30	37%
1972	344	341	685	50%	307	286	593	48%	15	31	46	67%	22	24	46	52%
1973	349	308	657	47%	316	263	579	45%	15	25	40	63%	18	20	38	53%
1974	345	306	651	47%	307	243	550	44%	13	35	48	73%	25	28	53	53%
1975	354	322	676	48%	313	269	582	46%	18	33	51	65%	23	20	43	47%
1976	388	329	717	46%	356	282	638	44%	11	25	36	69%	21	22	43	51%
1977	441	402	843	48%	399	351	750	47%	9	25	34	74%	33	26	59	44%
1978	425	357	782	46%	377	287	664	43%	14	31	45	69%	34	39	73	53%
1979	469	345	814	42%	424	283	707	40%	14	29	43	67%	31	33	64	52%
1980	457	365	822	44%	397	285	682	42%	16	49	65	75%	44	31	75	41%
1981	433	358	791	45%	384	290	674	43%	13	31	44	70%	36	37	73	51%
1982	429	333	762	44%	375	261	636	41%	16	30	46	65%	38	42	80	53%
1983	397	377	774	49%	351	304	655	46%	9	31	40	78%	37	42	79	53%
1984	459	348	807	43%	407	274	681	40%	16	37	53	70%	36	37	73	51%
1985	497	363	860	42%	439	296	735	40%	19	35	54	65%	39	32	71	45%
1986	479	341	820	42%	416	271	687	39%	25	28	53	53%	38	42	80	53%
1987	464	373	837	45%												
1988																

Source: Gathered and compiled by author from "University Data Resources", Zaidanhojin Jinbunkyo Kyokai (reference documents 9 to 33).

Note : Unit is individual person.

Note :(1) Fiscal years 1964, 1965 and 1969 were computed by the following formula.

FY1964=(total at end of FY1964)
-(total at end of FY1963)

FY1965=(total at end of FY1965)
-(total at end of FY1964)

FY1969=(total at end of FY1970)
-((FY1970)+(total at end of FY1968))

(2) To insure correct values, revisions in the university data sources were made as follows : for the total of public school science doctorates in fiscal 1963,36 was changed to 16; for the total of private university science doctorates in fiscal 1970,28 was changed to 27;for the total of science doctorates in 1968, 1836 was changed to 1863 ; and for the total at the end of FY1970,4716 was changed to 4746.

Table 4. List of Total Number of Science Doctorates by University

Fiscal year	National U.								Private U.
	Hok	Toh	Tok	Toko	Nag	Kyo	Osa	Kyu	Waseda
1970 A	174	268	656	175	145	214	300	77	17
B	161	316	400	62	109	352	199	96	4
Total	335	584	1056	237	254	566	499	173	21
1971 A	197	317	757	208	165	238	345	89	24
B	177	347	447	82	132	385	227	114	5
Total	374	664	1204	290	297	623	572	203	29
1972 A	216	353	833	220	185	283	383	101	35
B	197	396	493	97	152	430	248	148	7
Total	413	759	1326	317	337	713	631	249	42
1973 A	243	407	920	244	202	324	417	117	41
B	216	429	536	105	170	465	288	170	10
Total	459	836	1456	349	372	789	705	287	51
1974 A	266	452	1019	260	220	358	442	131	49
B	236	460	586	116	183	489	297	192	17
Total	502	912	1605	376	403	847	739	323	66
1975 A	293	498	1119	271	238	394	475	144	59
B	269	495	637	127	194	529	323	213	21
Total	562	993	1756	398	432	923	798	357	80
1976 A	322	546	1219	291	250	454	512	156	69
B	301	521	683	141	213	567	339	231	27
Total	623	1067	1902	432	463	1021	851	387	96
1977 A	354	589	1320	321	278	519	542	176	79
B	336	548	757	152	246	609	356	257	30
Total	690	1137	2077	473	524	1128	898	433	109
1978 A	388	635	1421	346	304	570	580	200	94
B	362	586	801	169	275	649	380	273	35
Total	750	1221	2222	515	579	1219	960	473	129
1979 A	429	683	1532	369	325	631	626	222	105
B	396	636	847	179	297	687	398	295	41
Total	825	1319	2379	548	622	1318	1024	517	146
1980 A	471	735	1637	393	345	689	654	255	119
B	418	660	897	195	326	728	417	326	45
Total	889	1395	2534	588	671	1417	1071	581	164
1981 A	504	794	1753	422	366	736	579	274	131
B	441	697	944	205	355	783	436	342	56
Total	945	1491	2697	627	721	1519	1115	616	187
1982 A	531	836	1849	447	388	809	701	301	146
B	457	732	983	217	374	821	461	364	57
Total	988	1568	2832	664	762	1630	1162	665	203
1983 A	555	885	1935	469	410	854	730	332	163
B	479	759	1052	237	408	853	483	388	59
Total	1034	1644	2987	706	818	1727	1213	720	222
1984 A	587	936	2041	499	433	913	758	362	175
B	496	783	1100	257	432	901	502	415	68
Total	1083	1719	3141	756	865	1814	1270	777	243
1985 A	619	992	2157	524	464	987	801	390	185
B	516	838	1140	270	459	942	521	432	76
Total	1135	1830	3307	794	923	1929	1322	822	261
1986 A	646	1031	2270	559	497	1051	840	413	195
B	546	856	1184	294	482	972	546	462	82
Total	1192	1887	3454	853	979	2033	1386	875	277

Source: Gathered and compiled by author from "University Data Resources," Zaidanhojin Jinbukyo Kyokai (reference documents 9 to 33).

Note : Unit is individual person.
A is course-work doctorates and B is dissertation doctorates.
Hok is Hokkaido University
Toh is Touhoku University
Tok is University of Tokyo
Toko is Tokyo Institute of Technology
Nag is Nagoya University
Kyo is Kyoto University
Osa is Osaka University
Kyu is Kyushuu University
Waseda is waseda University

Table 5. Number of Science Doctorates Awarded Per Year by University

Fiscal year	National											Private			
	Hok	Toh	Tok	Toko	Nag	Kyo	Osa	Kyu	Sub-Total	Other	Total	Waseda	Keio	Other	Total
1970 A											301				13
B											240				14
Total											541				27
1971 A	23	49	91	33	20	24	45	12	297	26	323	7	0	12	19
B	16	31	47	20	23	33	28	18	216	51	267	1	0	10	11
Total	39	80	138	53	43	57	73	30	513	77	590	8	0	22	30
1972 A	19	46	76	12	20	45	38	12	268	39	307	11	0	11	22
B	20	49	46	15	20	45	21	34	250	36	286	2	0	22	24
Total	39	95	122	27	40	90	59	46	518	75	593	13	0	33	46
1973 A	27	44	87	24	17	41	34	16	290	26	316	6	0	12	18
B	19	33	43	8	18	35	40	22	218	45	263	3	0	17	20
Total	46	77	130	32	35	76	74	38	508	71	579	9	0	29	38
1974 A	23	45	99	16	18	34	25	14	274	33	307	8	0	17	25
B	20	31	50	11	13	24	9	22	180	63	243	7	0	21	28
Total	43	76	149	27	31	58	34	36	454	96	550	15	0	38	53
1975 A	27	46	100	11	18	36	33	13	284	29	313	10	0	13	23
B	33	35	51	11	11	40	26	21	228	41	269	4	0	16	20
Total	60	81	151	22	29	76	59	34	512	70	582	14	0	29	43
1976 A	29	48	100	20	12	60	37	12	318	38	356	10	0	11	21
B	32	26	46	14	19	38	16	18	209	73	282	6	0	16	22
Total	61	74	146	34	31	98	53	30	527	111	638	16	0	27	43
1977 A	32	43	101	30	28	65	30	20	349	50	399	10	0	23	33
B	35	27	74	11	33	42	17	25	265	86	351	3	0	23	26
Total	67	70	175	41	61	107	47	45	614	136	750	13	0	46	59
1978 A	34	46	101	25	26	51	38	24	345	32	377	15	0	19	34
B	26	38	44	17	29	40	24	16	234	53	287	5	0	34	39
Total	60	84	145	42	55	91	62	40	579	85	664	20	0	53	73
1979 A	41	48	111	23	21	61	45	22	373	51	424	11	0	20	31
B	34	50	46	10	22	38	18	22	240	43	283	6	0	27	33
Total	75	98	157	33	43	99	64	44	613	94	707	17	0	47	64
1980 A	42	52	105	24	20	58	28	33	362	35	397	14	0	30	44
B	22	24	50	16	29	41	19	31	232	53	285	4	0	27	31
Total	64	76	155	40	49	99	47	64	594	88	682	18	0	57	75
1981 A	33	59	116	29	21	47	25	19	349	35	384	12	0	24	36
B	23	37	47	10	29	55	19	16	236	54	290	11	0	26	37
Total	56	96	163	39	50	102	44	35	585	89	674	23	0	50	73
1982 A	27	42	96	25	22	73	22	27	334	41	375	15	0	23	38
B	16	35	39	12	19	38	25	22	206	55	261	1	0	41	42
Total	43	77	135	37	41	111	47	49	540	96	636	16	0	64	80
1983 A	24	49	86	22	22	55	29	31	318	33	351	17	0	20	37
B	22	27	69	20	34	42	22	24	260	44	304	2	0	40	42
Total	46	76	155	42	56	97	51	55	578	77	655	19	0	60	79
1984 A	32	51	106	30	23	49	38	30	359	48	407	12	0	24	36
B	17	24	48	20	24	38	19	27	217	57	274	9	0	28	37
Total	49	75	154	50	47	87	57	57	576	105	681	21	0	52	73
1985 A	32	56	126	25	31	74	33	28	405	34	439	10	0	29	39
B	20	55	40	13	27	41	19	17	232	64	296	8	0	24	32
Total	52	111	166	38	58	115	52	45	637	98	735	18	0	53	71
1986 A	27	39	103	35	33	74	39	23	373	43	416	10	0	28	38
B	30	18	44	24	23	30	25	30	224	47	271	6	0	36	42
Total	57	57	147	59	56	104	64	53	597	90	687	16	0	64	80

Source: Gathered and compiled by author from "University Data Resources," Zaidanhojin Jinbunkyo Kyoukai (reference documents 9 to 33).

Note : Unit is individual person. A is course-work doctorates and B is dissertation doctorates.
Hok is Hokkaido University
Toh is Touhoku University
Tok is University of Tokyo
Toko is Tokyo Institute of Technology
Nag is Nagoya University
Kyo is Kyoto University
Osa is Osaka University
Kyu is Kyushuu University
Waseda is Waseda University
Keio is Keioo university

Table 6. Percentage of Science Dissertation Doctorates by University

Fiscal year	National											Private			
	Hok	Toh	Tok	Toko	Nag	Kyo	Osa	Kyu	Sub-total	Other	Total	Waseda	Keio	Other	Total
1970															
1971	41%	39%	34%	38%	53%	58%	38%	60%	42%	66%	45%	13%		45%	37%
1972	51%	52%	38%	56%	50%	50%	36%	74%	48%	48%	48%	15%		67%	52%
1973	41%	43%	33%	25%	51%	46%	54%	58%	43%	63%	45%	33%		59%	53%
1974	47%	41%	34%	41%	42%	41%	26%	61%	40%	66%	44%	47%		55%	53%
1975	55%	43%	34%	50%	38%	53%	44%	62%	45%	59%	46%	29%		55%	47%
1976	52%	35%	32%	41%	61%	39%	30%	60%	40%	66%	44%	38%		59%	51%
1977	52%	39%	42%	27%	54%	39%	36%	57%	43%	63%	47%	23%		50%	44%
1978	43%	45%	30%	40%	53%	44%	39%	40%	40%	62%	43%	25%		64%	53%
1979	45%	51%	29%	30%	51%	38%	28%	50%	39%	46%	40%	35%		57%	52%
1980	34%	32%	32%	40%	59%	41%	40%	48%	39%	60%	42%	22%		47%	41%
1981	41%	39%	29%	26%	58%	54%	43%	46%	40%	61%	43%	48%		52%	51%
1982	37%	45%	29%	32%	46%	34%	53%	45%	38%	57%	41%	6%		64%	53%
1983	48%	36%	45%	48%	61%	43%	43%	44%	45%	57%	46%	11%		67%	53%
1984	35%	32%	31%	40%	51%	44%	33%	47%	38%	54%	40%	43%		54%	51%
1985	38%	50%	24%	34%	47%	36%	37%	38%	36%	65%	40%	44%		45%	45%
1986	53%	32%	30%	41%	41%	29%	39%	57%	38%	52%	39%	38%		56%	53%
1987															
1988															

Source: Gathered and compiled by author from "University Data Resources," Zaidanhojin Jinbunkyo Kyoukai (reference documents 9 to 33).

Note : Unit is individual person.
Hok is Hokkaido University
Toh is Touhoku University
Tok is University of Tokyo
Toko is Tokyo Institute of Technology
Nag is Nagoya University
Kyo is Kyoto University
Osa is Osaka University
Kyu is Kyushuu University
Waseda is Waseda University
Keio is Keioo university

Table 7. Trend in Number of Engineering Doctorates and in Percentage of Dissertation Doctorates Among Them (by national, public and private universities)

Fiscar year	Science total				National				Public				Private			
	Course	Dissertation	Total	Rate	Course	Dissertation	Total	Rate	Course	Dissertation	Total	Rate	Course	Dissertation	Total	Rate
1957	25	0	25	0%	21	0	21	0%	0	0	0		4	0	4	0%
1958	83	0	83	0%	73	0	73	0%	2	0	2	0%	8	0	8	0%
1959	66	0	66	0%	62	0	62	0%	1	0	1	0%	3	0	3	0%
1960	72	6	78	8%	62	4	66	6%	3	2	5	40%	7	0	7	0%
1961	69	17	86	20%	68	13	81	16%	0	3	3	100%	1	1	2	50%
1962	84	54	138	39%	80	43	123	35%	2	6	8	75%	2	5	7	71%
1963	94	116	210	55%	83	92	175	53%	4	3	7	43%	7	21	28	75%
1964	112	209	321	65%	101	187	288	65%	4	11	15	73%	7	11	18	61%
1965	156	263	419	63%	138	215	353	61%	10	16	26	62%	8	32	40	80%
1966	193	299	492	61%	169	266	435	61%	10	14	24	58%	14	19	33	58%
1967	272	333	605	55%	250	280	530	53%	5	14	19	74%	17	39	56	70%
1968	305	323	628	51%	261	285	546	52%	15	12	27	44%	29	26	55	47%
1969	400	338	738	46%	342	282	624	45%	22	25	47	53%	36	31	67	46%
1970	425	428	853	50%	378	354	732	48%	24	35	59	59%	23	39	62	63%
1971	428	417	845	49%	368	370	738	50%	18	19	37	51%	42	28	70	40%
1972	381	472	853	55%	321	393	714	55%	15	22	37	59%	45	57	102	56%
1973	436	494	930	53%	372	417	789	53%	17	34	51	67%	47	43	90	48%
1974	479	521	1000	52%	403	435	838	52%	15	33	48	69%	61	53	114	46%
1975	456	530	986	54%	411	440	851	52%	9	32	41	78%	36	58	94	62%
1976	490	589	1079	55%	409	480	889	54%	19	33	52	63%	62	76	138	55%
1977	485	558	1043	53%	398	465	863	54%	16	31	47	66%	71	62	133	47%
1978	523	643	1166	55%	441	543	984	55%	12	30	42	71%	70	70	140	50%
1979	545	650	1195	54%	458	549	1007	55%	14	21	35	60%	73	80	153	52%
1980	523	663	1186	56%	434	543	977	56%	16	26	42	62%	73	94	167	56%
1981	541	695	1236	56%	456	579	1035	56%	16	29	45	64%	69	87	156	56%
1982	506	772	1278	60%	404	646	1050	62%	11	34	45	76%	91	92	183	50%
1983	489	801	1290	62%	396	655	1051	62%	14	25	39	64%	79	121	200	61%
1984	447	844	1291	65%	365	705	1070	66%	5	44	49	90%	77	95	172	55%
1985	480	924	1404	66%	408	760	1168	65%	7	50	57	88%	65	114	179	64%
1986	505	988	1493	66%	421	808	1229	66%	11	53	64	83%	73	127	200	64%
1987	621	926	1547	60%												
1988																

Source: Gathered and compiled by author from "University Data Resources," Zaidanhojin Jinbunkyo Kyoukai (reference documents 9 to 33).

Note : Unit is individual person.

Note: (1) Fiscal years 1964, 1965 and 1969 were computed by the following formula.

FY1964=(total at end of FY1964) -(total at end of FY1963)

FY1965=(total at end of FY1965) -(total at end of FY1964)

FY1969=(total at end of FY1970) -((FY1970)+(total at end of FY1968))

(2) To insure correct values, revisions in the university data sources were made as follows: for the total of public school engineering doctorates in fiscal 1963, 6 was changed to 7.

Table 8. List of Total Number of Engineering Doctorates by University

Fiscal year		National U.								Private U.	
		Hok	Toh	Tok	Toko	Nag	Kyo	Osa	Kyu	Waseda	Keio
1970	A	55	310	698	297	105	253	336	35	87	41
	B	64	137	595	299	111	425	294	95	86	59
	Total	119	447	1293	596	216	678	630	131	173	100
1971	A	75	359	793	357	137	296	394	46	98	50
	B	80	156	686	343	133	515	353	125	98	64
	Total	155	515	1479	700	270	811	747	171	196	114
1972	A	95	405	873	402	171	327	447	58	112	61
	B	113	183	784	395	160	599	408	142	120	71
	Total	208	588	1657	797	331	926	855	200	232	132
1973	A	109	457	982	456	195	364	512	75	135	78
	B	138	218	887	441	188	689	473	167	136	81
	Total	247	675	1869	897	383	1053	985	242	271	159
1974	A	129	502	1082	522	224	416	585	93	157	93
	B	162	239	989	484	221	782	557	202	151	99
	Total	291	741	2071	1006	445	1198	1142	295	308	192
1975	A	152	558	1196	579	254	458	654	113	172	100
	B	183	290	1080	544	263	884	607	225	168	111
	Total	335	848	2276	1123	517	1342	1261	338	340	211
1976	A	170	621	1307	631	280	504	733	127	193	116
	B	203	333	1200	596	295	979	691	259	188	127
	Total	373	954	2507	1227	575	1483	1424	386	381	243
1977	A	195	680	1391	703	310	551	798	143	224	134
	B	228	380	1308	644	339	1059	768	295	208	139
	Total	423	1060	2699	1347	649	1610	1565	438	432	273
1978	A	222	741	1506	773	337	607	856	169	249	155
	B	259	436	1423	706	381	1183	848	328	229	153
	Total	481	1177	2929	1479	718	1790	1704	497	478	308
1979	A	252	804	1622	850	361	662	922	193	276	171
	B	296	481	1543	774	436	1289	927	357	250	174
	Total	548	1285	3165	1624	797	1951	1849	550	526	345
1980	A	284	847	1744	917	386	713	983	217	302	193
	B	321	544	1658	844	474	1387	1015	407	270	190
	Total	605	1391	3402	1761	860	2100	1998	624	572	383
1981	A	306	896	1858	999	411	770	1054	244	327	214
	B	366	607	1799	920	499	1471	1114	449	291	212
	Total	672	1503	3657	1919	910	2241	2168	693	618	425
1982	A	338	929	1956	1055	435	821	1105	280	354	241
	B	411	659	1931	1016	541	1584	1208	508	308	227
	Total	749	1588	3887	2071	976	2405	2314	788	662	468
1983	A	362	971	2060	1115	458	859	1172	315	373	261
	B	470	720	2035	1107	593	1694	1325	556	337	248
	Total	832	1691	4096	2222	1051	2553	2497	871	710	509
1984	A	387	1010	2148	1181	473	889	1217	350	393	277
	B	526	777	2166	1192	668	1815	1435	605	362	262
	Total	913	1787	4314	2373	1141	2704	2652	955	755	539
1985	A	408	1051	2249	1241	501	925	1278	387	406	304
	B	568	836	2361	1298	710	1938	1563	650	396	279
	Total	976	1887	4510	2539	1211	2863	2841	1047	802	583
1986	A	435	1092	2346	1303	528	972	1339	403	427	324
	B	625	900	2557	1384	774	2045	1698	733	436	298
	Total	060	1992	4903	2687	1302	3017	3037	1141	863	622

Source: Gathered and compiled by author from "University Data Resources," Zaidanhojin Jinbunkyo Kyoukai (reference documents 9 to 33).

Note : Unit is individual person.
A is course-work doctorates and B is dissertation doctorates.
Hok is Hokkaido University
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Toko is Tokyo Institute of Technology
Nag is Nagoya University
Kyo is Kyoto University
Osa is Osaka University
Kyu is Kyushuu University
Waseda is Waseda University
Keio is Keioo university

Table 9. Number of Engineering Doctorates Awarded Per Year by University

Fiscal year	National											Private			
	Hok	Toh	Tok	Toko	Nag	Kyo	Osa	Kyu	Sub-Total	Other	Total	Waseda	Keio	Other	Total
1970 A											378				23
B											354				39
Total											732				62
1971 A	20	49	95	60	32	43	58	11	368	0	368	11	9	22	42
B	16	19	91	44	22	90	59	29	370	0	370	12	5	11	28
Total	36	68	186	104	54	133	117	40	738	0	738	23	14	33	70
1972 A	20	46	80	45	34	31	53	12	321	0	321	14	11	20	45
B	33	27	98	52	27	84	55	17	393	0	393	22	7	28	57
Total	53	73	178	97	61	115	108	29	714	0	714	36	18	48	102
1973 A	14	52	109	54	24	37	65	17	372	0	372	23	17	7	47
B	25	35	103	46	28	90	65	25	417	0	417	16	10	17	43
Total	39	87	212	100	52	127	130	42	789	0	789	39	27	24	90
1974 A	20	45	100	66	29	52	73	18	403	0	403	22	15	24	61
B	24	21	102	43	33	93	84	35	435	0	435	15	18	20	53
Total	44	66	202	109	62	145	157	53	838	0	838	37	33	44	114
1975 A	23	56	114	57	30	42	69	20	411	0	411	15	7	14	36
B	21	51	91	60	42	102	50	23	440	0	440	17	12	29	58
Total	44	107	205	117	72	144	119	43	851	0	851	32	19	43	94
1976 A	18	63	111	52	26	46	79	14	409	0	409	21	16	25	62
B	20	43	120	52	32	95	84	34	480	0	480	20	16	40	76
Total	38	106	231	104	58	141	163	48	889	0	889	41	32	65	138
1977 A	25	59	84	72	30	47	65	16	398	0	398	31	18	22	71
B	25	47	108	48	44	80	77	36	465	0	465	20	12	30	62
Total	50	106	192	120	74	127	142	52	863	0	863	51	30	52	133
1978 A	27	61	115	70	27	55	58	26	440	1	441	25	21	24	70
B	31	56	115	62	42	124	80	33	543	0	543	21	14	35	70
Total	58	117	230	132	69	180	138	59	983	1	984	46	35	59	140
1979 A	30	63	116	77	24	55	66	24	455	3	458	27	16	30	73
B	37	45	120	68	55	106	79	39	549	0	549	21	21	38	80
Total	67	108	236	145	79	161	145	63	1004	3	1007	48	37	68	153
1980 A	32	43	122	67	25	51	61	24	425	9	434	26	22	25	73
B	25	63	115	70	38	98	88	40	537	6	543	20	16	58	94
Total	57	106	237	137	63	149	149	64	952	15	977	46	38	83	167
1981 A	22	49	114	82	25	57	71	27	447	9	456	25	21	23	69
B	45	63	141	76	25	84	99	42	575	4	579	21	22	44	87
Total	67	112	255	158	50	141	170	69	1022	13	1035	46	43	67	156
1982 A	32	33	108	56	24	51	52	36	392	12	404	27	27	37	91
B	45	52	132	96	42	113	94	59	633	13	646	17	15	60	92
Total	77	85	240	152	66	164	146	95	1025	25	1050	44	42	97	183
1983 A	24	42	94	60	23	38	65	35	382	14	396	19	20	40	79
B	59	61	105	91	52	110	117	48	643	12	655	29	21	71	121
Total	83	103	199	151	75	148	183	83	1025	26	1051	48	41	111	200
1984 A	25	39	88	66	15	30	45	35	343	22	365	20	16	41	77
B	56	57	130	85	75	121	110	50	684	21	705	25	14	55	95
Total	81	96	218	151	90	151	155	85	1027	43	1070	45	30	97	172
1985 A	21	41	101	60	28	36	61	37	385	23	408	13	27	25	65
B	42	59	195	106	42	123	128	54	749	11	760	34	17	63	114
Total	63	100	296	165	70	159	189	91	1134	34	1158	47	44	88	179
1986 A	27	41	97	62	27	47	61	21	383	38	421	21	20	32	73
B	57	64	196	86	64	107	135	73	782	26	808	40	19	68	127
Total	84	105	293	148	91	154	196	94	1155	64	1229	61	39	100	200

Source: Gathered and compiled by author from "University Data Resources," Zaidanhojin Jinbunkyo Kyoukai (reference documents 9 to 33).

Note : Unit is individual person.
A is course-work doctorates and B is dissertation doctorates.
Hok is Hokkaido University
Toh is Touhoku University
Tok is University of Tokyo
Toko is Tokyo Institute of Technology
Nag is Nagoya University
Kyo is Kyoto University
Osa is Osaka University
Kyu is Kyushuu University
Waseda is Waseda University
Keio is Keioo university

Table 10. Percentage of Engineering Dissertation Doctorates by University

	National U.											Private U.			
Fiscal year	Hok	Toh	Tok	Toko	Nag	Kyo	Osa	Kyu	sub-total	Other	Total	Waseda	Keio	Other	Total
1970															
1971	44%	28%	49%	42%	41%	68%	50%	73%	50%		50%	52%	36%	33%	40%
1972	62%	37%	55%	54%	44%	73%	51%	59%	55%		55%	61%	39%	58%	56%
1973	64%	40%	49%	46%	54%	71%	50%	60%	53%		53%	41%	37%	71%	48%
1974	55%	32%	50%	39%	53%	64%	54%	66%	52%		52%	41%	55%	45%	46%
1975	48%	48%	44%	51%	58%	71%	42%	53%	52%		52%	53%	63%	67%	62%
1976	53%	41%	52%	50%	55%	67%	52%	71%	54%		54%	49%	50%	62%	55%
1977	50%	44%	56%	40%	59%	63%	54%	69%	54%		54%	39%	40%	58%	47%
1978	53%	48%	50%	47%	61%	69%	58%	56%	55%	0%	55%	46%	40%	59%	50%
1979	55%	42%	51%	47%	70%	66%	54%	62%	55%	0%	55%	44%	57%	56%	52%
1980	44%	59%	49%	51%	60%	66%	59%	63%	56%	40%	56%	43%	42%	70%	56%
1981	67%	56%	55%	48%	50%	60%	58%	61%	56%	31%	56%	46%	51%	66%	56%
1982	58%	61%	55%	63%	64%	69%	64%	62%	62%	52%	62%	39%	36%	62%	50%
1983	71%	59%	53%	60%	69%	74%	64%	58%	63%	46%	62%	60%	51%	64%	61%
1984	69%	59%	60%	56%	83%	80%	71%	59%	67%	49%	66%	56%	47%	58%	55%
1985	67%	59%	66%	64%	60%	77%	68%	59%	66%	32%	65%	72%	39%	72%	64%
1986	68%	61%	67%	58%	70%	69%	69%	78%	67%	41%	66%	66%	49%	68%	64%
1987															
1988															

Source: Gathered and compiled by author from "University Data Resources," Zaidanhojin Jinbunkyo Kyoukai (reference documents 9 to 33).

Note : Unit is individual person.
Hok is Hokkaido University
Toh is Touhoku University
Tok is University of Tokyo
Toko is Tokyo Institute of Technology
Nag is Nagoya University
Kyo is Kyoto University
Osa is Osaka University
Kyu is Kyushuu University
Waseda is Waseda University
Keio is Keioo university

Table 11. Age Distribution of New Science Doctorates by University
— FY1960

Age	Tohoku		Kyoto		Kyushu		Tokyo		Total	
	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation
27			1	1	2		13		16	1
28	3		5	2	3	2	14		25	4
29	1		2	2	2		9	1	14	3
30	1		3	1	2		5	1	11	2
31			1	1			2		3	1
32									0	0
33	1		1				1		3	0
34									0	0
35									0	0
36							1		1	0
37									0	0
38									0	0
39									0	0
40									0	0
41									0	0
42									0	0
43									0	0
44									0	0
45									0	0
46									0	0
47									0	0
48									0	0
49									0	0
50									0	0
51									0	0
52									0	0
53									0	0
54									0	0
55									0	0
56									0	0
57									0	0
58									0	0
59									0	0
60									0	0
61									0	0
62									0	0
63									0	0
64									0	0
65									0	0
66									0	0
67									0	0
total	6	0	13	7	9	2	45	2	73	11
average	29.3		29.2	28.9	28.4	28	28.6	29.5	28.7	28.8
median										

Source: Compiled by author from name list in "Record of Japanese Doctorates (1957 to 1961 editions)," Teikoku Chiho Gyosei Gakkai.

Note : Unit is individual person. Figures in parenthesis represent foreign students and they are excluded. Foreigners are not included in calculation of full age and average age as of March 31, 1961.
Tohoku is Touhoku University
Tokyo is University of Tokyo
Kyoto is Kyoto University
Kyushu is Kyushuu University

Table 12. Age Distribution of New Science Doctorates by University
— FY1965

Age	Tohoku		Kyoto		Kyushu		Tokyo		Total	
	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation
27	8		2		2		10		22	0
28	6	1	3	(1) 3			14	1	23	(1) 5
29	2			(1) 1		1	12	4	14	(1) 6
30	3	3	3	2	1		2	1	9	6
31	(1)	1	4	2		2	4	5	(1) 8	10
32		2	1	3	1		1	5	3	10
33	1	(1) 6	1	4		1	1	3	3	(1) 14
34		5		3		2		7	0	17
35		8		3		1		5	0	17
36		3		2		(1)	1		1	(1) 5
37		1		2				3	0	6
38		3		2		1		1	0	7
39		3		3				4	0	10
40			1	4				1	1	5
41		1		3		1			0	5
42		1							0	1
43		1		1				1	0	3
44		1							0	1
45		(1) 2							0	(1) 2
46		1		1				1	0	3
47		1							0	1
48				1					0	1
49		1		1					0	2
50									0	0
51								1	0	1
52									0	0
53				2					0	2
54									0	0
55		1						1	0	2
56		1							0	1
57		1		1					0	2
58									0	0
59				1					0	1
60									0	0
61									0	0
62									0	0
63									0	0
64									0	0
65									0	0
66									0	0
67									0	0
total	(1) 20	(2) 48	15	(2) 45	4	(1) 9	45	44	(1) 84	(3) 146
average	28.3	37.6	30.5	37.8	29	34	28.8	35	29	36.7

Source: Compiled by author from name list in "Record of Japanese Doctorates (1965 edition)," Teikoku Chiho Gyosei Gakkai.

Note : Unit is individual person.
Figures in parenthesis represent foreign students and they are excluded. Foreigners are not included in calculation of full age and average age as of March 31, 1966.
Tohoku is Touhoku University
Tokyo is University of Tokyo
Kyoto is Kyoto University
Kyushu is Kyushuu University

Table 13. Age Distribution of New Science Doctorates by University
— FY1970

Age	Tohoku		Kyoto		Kyushu		Tokyo		Total	
	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation
27	13		2		3		22		40	0
28	13		6	1	2	1	(1) 24	4	(1) 45	6
29	6	1	7	2	1	2	17	3	31	8
30	1	2	11	3		1	11	12	23	18
31	3	2	4	3			5	4	12	9
32	1	(1) 2	1		1		2	5	5	(1) 7
33		4		(1) 6	1	1	1	5	2	(1) 16
34		4		(1) 1		1	2	6	2	(1) 12
35		5		2	1			2	1	9
36		4				1		2	0	7
37				1		1	1	1	1	3
38	(2)	2		3					(2) 0	5
39		5		(1) 2					0	(1) 7
40		3		1				1	0	5
41		1		1		1		2	0	5
42		2		2				1	0	5
43		2		1				1	0	4
44				1					0	1
45		2		2				1	0	5
46		1		1		2			0	4
47		1							0	1
48						1			0	1
49								1	0	1
50									0	0
51				1					0	1
52									0	0
53									0	0
54									0	0
55		2							0	2
56								1	0	1
57									0	0
58									0	0
59		1		1				(1)	0	(1) 2
60									0	0
61									0	0
62									0	0
63									0	0
64									0	0
65									0	0
66									0	0
67									0	0
total	(2) 37	(1) 46	31	(3) 35	9	12	(1) 85	(1) 52	(3) 62	(5) 145
average	28.2	38.2	29.4	37.1	29.6	36.4	28.8	33.6	28.8	36.1

Source: Compiled by author from name list in "Record of Japanese Doctorates (1970 edition)," Koojunsha.

Note : Unit is individual person.
Figures in parenthesis represent foreign students and they are excluded. Foreigners are not included in calculation of full age and average age as of March 31, 1971.
Tohoku is Touhoku University
Tokyo is University of Tokyo
Kyoto is Kyoto University
Kyushu is Kyushuu University

Table 14. Age Distribution of New Science Doctorates by University
— FY1988

Age	Tohoku		Kyoto		Kyushu		Tokyo		Total	
	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation
27	16		12		10				38	0
28	(1)12		24	2	8	1			(1)44	3
29	(1) 9	2	5	1	3				(1)17	3
30	(1) 3		(1) 8		3				(2)14	0
31		3	(1) 7	4	4	2			(1)11	9
32			(1) 9	2	(2) 3	3			(3)12	5
33	1	1	1	2	1	1			3	4
34		2	4	5	1	1			5	8
35		2		2					0	4
36			(2)	1		1			(2) 0	2
37	(1)	6	2	1		3			(1) 2	10
38		2		5	(1)	3			(1) 0	10
39		1		3	1				1	4
40		2	(1)	3		1			(1) 0	6
41				3		2			0	5
42		1		1		2			0	4
43		2		3		(1)			0	(1) 5
44				1		1			0	2
45		3				1			0	4
46		1		1					0	2
47		1		3					0	4
48				1					0	1
49				(2) 1					0	(2) 1
50									0	0
51		1		1					0	2
52		2		2					0	4
53									0	0
54				1					0	1
55									0	0
56									0	0
57				1					0	1
58		1							0	1
59		1							0	1
60				1					0	1
61									0	0
62									0	0
63									0	0
64		1							0	1
65									0	0
66									0	0
67									0	0
total	(4)41	35	(6)72	(2)51	(3)34	(1)22			(13)147	(3)108
average	28.1	40.9	29.6	39.7	29.3	36.8			29.1	39.5
median										

Source: Compiled by author from materials of the National Diet Library.

Note : Unit is individual person.
Figures in parenthesis represent foreign students and they are excluded. Foreigners are not included in calculation of full age and average age as of March 31, 1989.
Tohoku is Touhoku University
Tokyo is University of Tokyo
Kyoto is Kyoto University
Kyushu is Kyushuu University

Table 15. Age Distribution of New Engineering Doctorates by University
— FY1960

Age	Tohoku		Kyoto		Kyushu		Tokyo		Total	
	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation
27	2		1				3		6	0
28	2		2				(1) 5		(1) 9	0
29			4	1			9		13	1
30	1		1	1	1		4		7	1
31	2		1				(1) 3		(1) 6	0
32									0	0
33				1					0	1
34									0	0
35									0	0
36									0	0
37								1	0	1
38									0	0
39									0	0
40									0	0
41									0	0
42									0	0
43									0	0
44									0	0
45									0	0
46									0	0
47									0	0
48									0	0
49									0	0
50									0	0
51									0	0
52									0	0
53									0	0
54									0	0
55									0	0
56									0	0
57									0	0
58									0	0
59									0	0
60									0	0
61									0	0
62									0	0
63									0	0
64									0	0
65									0	0
66									0	0
67									0	0
total	7	0	9	3	1	0	(2)24	1	(2)41	4
average	28.9		28.9	30.7	30		29	37	29	32.3

Source: Compiled by author from name list in "Record of Japanese Doctorates (1957 to 1961 editions)," Teikoku Chiho Gyosei Gakkai.

Note : Unit is individual person. Figures in parenthesis represent foreign students and they are excluded. Foreigners are not included in calculation of full age and average age as of March 31, 1961.
Tohoku is Touhoku University
Tokyo is University of Tokyo
Kyoto is Kyoto University
Kyushu is Kyushuu University

Table 16. Age Distribution of New Engineering Doctorates by University
— FY1965

Age	Tohoku		Kyoto		Kyushu		Tokyo		Total	
	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation
27	3						15		18	0
28	2		1				9		12	0
29	2		3	3			8	1	13	4
30	1	1	6	1			3		10	2
31	3		4	4			(2) 4	5	(2) 11	9
32	(1) 1	1		2	2		(1)	4	(2) 3	7
33			2	2			(1)	1	(1) 2	3
34		2	1	7		1	(2) 1	7	(2) 2	17
35		2		6	1	1		4	1	13
36				6				3	0	9
37		1		3		1		3	0	8
38		1		3		1		3	0	8
39				2		1		5	0	8
40		1		1				(1) 4	0	(1) 6
41				3		1		3	0	7
42				1				4	0	5
43								3	0	3
44								1	0	1
45		1						3	0	4
46								1	0	1
47									0	0
48									0	0
49								1	0	1
50									0	0
51		1		1				3	0	5
52				1				2	0	3
53								1	0	1
54				1					0	1
55								3	0	3
56				1					0	1
57								1	0	1
58				1					0	1
59									0	0
60									0	0
61									0	0
62									0	0
63									0	0
64									0	0
65									0	0
66				1					0	1
67									0	0
total	(1) 12	11	17	50	3	6	(6) 40	(1) 66	(7) 72	(1) 133
average	29.2	37.4	30.5	37.6	33	37.3	28:4	40	29.2	38,7

Source: Compiled by author from name list in " Record of Japanese Doctorates (1965 edition)," Teikoku Chiho Gyosei Gakkai.

Note : Unit is individual person.
Figures in parenthesis represent foreign students and they are excluded. Foreigners are not included in calculation of full age and average age as of March 31, 1966.
Tohhoku is Touhoku University
Tokyo is University of Tokyo
Kyoto is Kyoto University
Kyushu is Kyushuu University

Table 17. Age Distribution of New Engineering Doctorates by University
— FY1970

Age	Tohoku		Kyoto		Kyushu		Tokyo		Total	
	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation
27	13		3				29		45	0
28	20		(1)12				(1)33		(2)65	0
29	11		16	2	2	1	(1)13	1	(1)42	4
30	7		8	4	3		11	2	29	6
31	5	1	8	11		1	(1) 3	4	(1)16	17
32	2		4	6		1	1	3	7	10
33	1	6	1	6		1	(1) 2	3	(1) 4	16
34		1		3		1	1	3	1	8
35		4		6	1	2	(2)	3	(2) 1	15
36		1	1	4		3	(1)	10	(1) 1	18
37		4	1	3		3		2	1	12
38		2		7			(1)	(2) 7	(1) 0	(2)16
39		1		2		1		2	0	6
40		(1)		3		2		10	0	(1)15
41		1		2				7	0	10
42				1		1		2	0	4
43		3						3	0	6
44		3		4		1		8	0	16
45		2		1		2		2	0	7
46		1		1		1		4	0	7
47				2				5	0	7
48						1		1	0	2
49		1				1		2	0	4
50								1	0	1
51									0	0
52				1					0	1
53				1				2	0	3
54				1				1	0	2
55								(1) 1	0	(1) 1
56				1		1		1	0	3
57									0	0
58				1				2	0	3
59								2	0	2
60									0	0
61				1					0	1
62									0	0
63									0	0
64									0	0
65									0	0
66								1	0	1
67								1	0	1
total	59	(1)31	(1)54	74	6	24	(3)93	(3)96	(7)212	(7)225
average	28.7	38.4	29.7	37.3	30.5	39.3	28.4	41.5	28.9	39.5

Source: Compiled by author from name list in " Record of Japanese Doctorates (1970 edition)," Koojunsha.

Note : Unit is individual person.
Figures in parenthesis represent foreign students and they are excluded. Foreigners are not included in calculation of full age and average age as of March 31, 1971.
Tohoku is Touhoku University
Tokyo is University of Tokyo
Kyoto is Kyoto University
Kyushu is Kyushuu University

Table 18. Age Distribution of New Engineering Doctorates by University
— FY1988

Age	Tohoku		Kyoto		Kyushu		Tokyo		Total	
	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation	Course	Dissertation
27	(4)11		9		(4)11				(8)31	0
28	(4)11		(2)12		(2) 9				(8)32	0
29	(6) 4		(2) 7	1	6	2			(8)17	3
30	2	(1)	2	1	(1) 2	1			(1) 6	(1) 2
31	(7) 3	(1) 5	(1) 3	3	(3) 1	2			(11) 7	(1)10
32	(1) 1	3	(1) 2	5	(5)	1			(7) 3	9
33	(4)	5	(3) 2	8	(3)	1			(10) 2	14
34	(3)	3	2	8	(1)	3			(4) 2	14
35		(2) 1	(1)	(1) 3	(2)	2			(3) 0	(3) 6
36	(1)	5	(2)	4	(2)	3			(5) 0	12
37	(1)			3		(1) 3			(1) 0	(1) 6
38		6		4	(2)	3			(2) 0	13
39		1		(1) 9		2			0	(1)12
40		6		5	(2)	6			(2) 0	17
41		8		6		(1) 2			0	(1)16
42	(1)	1		8		4			(1) 0	13
43		1		1		4			0	6
44		3		3		8			0	14
45		(1) 4		4		6			0	(1)14
46		5		2		2			0	9
47	(1)	3		4		3			(1) 0	10
48		1		3		1			0	5
49		2		1		1			0	4
50				(1) 4	(1)				(1) 0	(1) 4
51		1		1		(1) 1			0	(1) 3
52		2		3		1			0	6
53		2							0	2
54		2		1					0	3
55		1		1		1			0	3
56		1		2		1			0	4
57						2			0	2
58		2							0	2
59		1							0	1
60				3		1			0	4
61									0	0
62				1		1			0	2
63		4							0	4
64									0	0
65		1							0	1
66									0	0
67									0	0
68				1					0	1
total	(33)32	(5)80	(12)39	(3)103	(28)29	(3)68	0	0	(78)100	(11)251
average	28.3	43.2	29.1	41.3	28.1	42.1			28.5	42.1

Source: Compiled by author from materials of the National Diet Library Gakkai.

Note : Unit is individual person.
Figures in parenthesis represent foreign students and they are excluded. Foreigners are not included in calculation of full age and average age as of March 31, 1989.
Tohoku is Touhoku University
Tokyo is University of Tokyo
Kyoto is Kyoto University
Kyushu is Kyushuu University

Table 19. Ages at Which Doctorate Degrees in Science and Engineering are Awarded in the United States

Source: NSF " science and engineering doctorates: 1960-87"

Table 4. Median age of science and engineering doctorates by major field and sex: 1960-87

Field of study	Median age in year of doctorate													
	1960-1964	1965-1969	1960-1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1970-1979
TOTAL, MALE AND FEMALE														
Total, sci/eng	30.2	29.5	29.7	29.1	29.3	29.6	29.9	30.0	29.8	29.9	30.0	30.1	30.2	29.8
Total, sciences	30.3	29.4	29.7	29.0	29.2	29.5	29.8	29.9	29.8	29.8	30.0	30.0	30.1	29.7
Physical sciences ..	28.5	28.1	28.3	28.2	28.3	28.6	28.9	28.8	28.7	28.8	29.0	29.0	28.6	28.6
Physics/astronomy.	29.0	28.5	28.7	28.6	28.8	29.0	29.2	29.3	29.3	29.1	29.5	29.5	29.2	29.1
Chemistry	28.2	27.7	27.9	27.9	27.9	28.3	28.5	28.5	28.3	28.5	28.6	28.7	28.2	28.3
Earth/atmos/mar sci.	30.6	30.5	30.5	30.5	30.4	30.5	30.5	31.0	30.7	30.2	30.5	30.5	30.3	30.5
Life sciences	30.8	30.1	30.4	29.2	29.4	29.7	30.0	29.9	29.7	29.7	29.7	29.8	29.8	29.7
Agricultural sci .	31.2	31.4	31.3	30.2	30.8	31.1	31.2	31.2	31.0	31.4	31.2	31.2	31.2	31.1
Biological sci ...	30.7	29.7	30.1	29.0	29.1	29.4	29.7	29.6	29.4	29.4	29.4	29.5	29.5	29.4
Social sciences	32.7	31.9	32.2	31.1	30.8	30.8	31.1	31.3	31.4	31.5	31.8	31.6	32.1	31.4
Psychology	31.1	29.8	30.4	29.0	28.9	29.3	29.5	29.4	29.5	29.6	29.9	30.1	30.6	29.6
Mathematics	29.3	28.1	28.4	28.1	28.4	28.9	29.1	29.2	29.1	29.1	29.0	29.3	29.3	28.9
Computer/info sci ..	*	*	*	*	*	*	*	*	*	*	29.5	30.1	30.1	30.1
Total, engineering	29.8	29.7	29.8	29.6	29.9	30.1	30.4	30.3	30.2	30.2	30.0	30.2	30.3	30.1
Chemical	28.5	28.3	28.4	28.6	28.5	28.6	29.1	29.0	29.2	29.1	29.1	29.2	28.4	28.9
Civil	30.8	31.0	30.9	30.3	31.0	30.7	31.5	31.3	31.5	31.9	31.3	30.9	31.4	31.2
Electrical	29.9	29.7	29.8	29.2	29.5	29.9	30.2	30.1	29.8	30.0	29.9	29.7	30.3	29.8
Materials sci	*	29.8	29.8	29.3	30.5	30.2	29.5	30.5	30.1	29.7	29.4	29.5	30.7	29.9
Mechanical	30.2	30.1	30.1	30.3	30.3	30.6	30.7	30.8	30.4	30.6	30.7	30.8	30.4	30.6
Total, non-sci/eng(1) .	35.5	35.3	35.4	34.6	34.5	34.3	34.1	34.0	34.3	34.3	34.5	34.7	34.9	34.4
Total, all fields	31.7	31.2	31.4	30.7	30.8	31.1	31.3	31.4	31.5	31.6	31.6	31.7	31.9	31.4

Table 4. Median age of science and engineering doctorates by major field and sex: 1960-87—con.

Field of study	Median age in year of doctorate									
	1980	1981	1982	1983	1984	1985	1986	1987	1980-1987	1960-1987
TOTAL, MALE AND FEMALE										
Total, sci/eng	30.2	30.3	30.5	30.7	31.0	31.1	31.3	31.4	30.8	30.1
Total, sciences	30.2	30.3	30.4	30.7	31.0	31.2	31.4	31.5	30.8	30.1
Physical sciences ..	28.7	28.6	28.8	29.0	29.1	29.2	29.5	29.4	29.1	28.6
Physics/astronomy.	29.4	29.1	29.6	29.5	29.5	29.8	30.0	30.0	29.6	29.1
Chemistry	28.3	28.3	28.3	28.6	28.7	28.9	29.2	29.0	28.7	28.3
Earth/atmos/mar sci.	30.8	30.9	30.7	31.0	31.6	31.3	31.8	31.9	31.2	30.8
Life sciences	29.7	29.8	29.9	30.2	30.6	30.9	31.1	31.2	30.4	30.1
Agricultural sci .	31.3	31.5	31.2	31.6	31.7	32.1	32.4	32.8	31.8	31.4
Biological sci ...	29.4	29.4	29.7	29.9	30.4	30.5	30.8	30.8	30.1	29.8
Social sciences	32.2	32.3	32.7	32.8	33.0	33.5	33.4	33.7	32.9	32.0
Psychology	30.6	31.4	31.5	32.0	32.3	32.4	33.0	33.1	32.0	30.7
Mathematics	29.3	29.2	29.4	29.6	30.2	30.4	30.0	30.8	29.8	29.0
Computer/info sci ..	29.5	30.1	29.9	30.9	31.2	31.1	32.0	31.7	30.9	30.8
Total, engineering	30.3	30.5	30.7	30.8	30.7	30.9	31.0	31.0	30.8	30.2
Chemical	29.0	29.2	29.3	29.3	29.2	29.3	29.3	29.1	29.2	28.9
Civil	31.9	31.4	31.4	31.4	31.4	31.6	32.0	32.2	31.7	31.3
Electrical	29.8	30.1	30.3	30.3	30.5	30.6	30.6	30.4	30.4	30.0
Materials sci	29.2	29.9	30.2	30.8	30.4	30.0	31.0	31.0	30.3	30.1
Mechanical	30.8	30.6	30.9	31.2	30.8	30.9	31.2	31.1	30.9	30.5
Total, non-sci/eng(1) .	35.3	35.5	35.8	36.1	36.7	37.1	37.5	37.6	36.5	35.4
Total, all fields	32.2	32.4	32.5	32.8	33.0	33.3	33.5	33.6	32.9	31.9

Source: NSF " science and engineering doctorates: 1960-87"

Table 20. Rate of Advancement by Science Department Graduates to University Science Master's Programs

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Department graduates a	10234	10688	11077	11554	11803	11755	11723	12234	12698	12814	13389	13388
Advance to master's program b	1701	1785	1875	1941	2008	2164	2194	2279	2445	2613	2817	3007
Rate of advancement b/a	16.6%	16.7%	16.9%	16.8%	17.0%	18.4%	18.7%	18.6%	19.3%	20.4%	21.0%	22.5%

Source: Ministry Education, Science, and Culture " Report of Basic Survey on Schools" (each year).

Table 21. Number of Enrollment Applications and Number of Enrollments in University Science Master's Program

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of enrollments a	1858	1922	2050	2124	2174	2357	2557	2775	2968
Index	100	103	107	114	117	127	138	149	160
Number of applicants b	5590	5215	5286	5115	4987	5193	5213	5634	5810
Ratio b/a	3.0	2.7	2.6	2.4	2.3	2.2	2.0	2.0	2.0

Source: Ministry Education, Science, and Culture " Report of Basic Survey on Schools" (each year).

Table 22. Number of Students Engaged in University Science Master's Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of active students	3741	3853	4040	4223	4361	4598	4982	5388	5815
Index	100	103	108	113	117	123	133	144	155

Source: Ministry Education, Science, and Culture " Report of Basic Survey on Schools" (each year).

Table 23. Rate of Advancement to University Science Doctorate Programs

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Department graduates a	10234	10688	11077	11554	11803	11755	11723	12234	12698	12814	13389	13388
Course masters b	1594	1625	1666	1649	1665	1716	1813	1910	1992	2019	2213	2377
Advancements to doctorate program c	765	710	661	632	605	611	624	659	612	655	753	752
Advancement by department c/a			6.5%	5.9%	5.5%	5.3%	5.3%	5.6%	5.2%	5.4%	5.9%	5.9%
Rate of advancement to master's program c/b	48.0%	43.7%	39.7%	38.3%	36.3%	35.6%	34.4%	34.5%	30.7%	32.4%	34.0%	31.6%

Source: Compiled by author from Ministry Education, Science, and Culture " Report of Basic Survey on Schools" (each year).

Note : The advancement rate by department for year X is calculated from number of advancement to doctor's programs in X/(X-2)year department graduates *100.

Table 24. Number of Enrollment Applications and Number of Enrollments in University Science Doctorate Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of enrollments a	657	622	623	646	695	689	701	845	802
Index	100	95	100	98	106	105	107	129	122
Number of applicants b	772	723	717	725	770	784	752	910	883
Ratio b/a	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 25. Employment Status of Those Who Complete University Science Master's Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Completed program	1649	1665	1716	1813	1910	1992	2019	2213	2377
Number of advancements	632	605	611	624	659	612	655	753	752
Number of unemployed	166	144	154	159	122	150	121	124	116
Number of employed	809	870	922	1005	1112	1208	1223	1306	1459
Employment rate (academic advancements excluded)	79.5%	82.1%	83.4%	84.5%	88.9%	87.5%	89.7%	89.5%	89.8%
Rate of unemployment (academic advancements excluded)	16.3%	13.6%	13.9%	13.4%	9.8%	10.9%	8.9%	8.5%	7.1%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 26. Number of Students Engaged in University Science Doctorate Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of active students	2589	2471	2403	2366	2485	2472	2524	2678	2829
Index	100	95	93	91	91	96	98	103	109

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 27. Rate of Advancement by Engineering Department Graduates to University Engineering Master's Programs

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Department graduates a	69221	71167	74128	73508	75188	73593	69620	70486	71396	73316	75843	76362
Advancements to master's program b	7270	6998	6945	7213	7597	8249	8327	9225	9905	10507	11431	12314
Rate of advancement b/a	10.5%	9.8%	9.4%	9.8%	10.1%	11.2%	12.0%	13.1%	13.9%	14.3%	15.1%	16.1%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 28. Number of Enrollment Applications and Number of Enrollments in University Engineering Master's Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of enrollments a	7572	7902	8585	8870	9884	10687	11422	12275	13109
Index	100	104	109	117	131	141	151	162	173
Number of applicants b	12692	12407	12904	12865	14189	15255	16034	17127	18281
Ratio b/a	1.7	1.6	1.5	1.5	1.4	1.4	1.4	1.4	1.4

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 29. Number of Students Engaged in University Engineering Master's Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of active students	14864	15581	16600	17521	18868	20668	22220	23862	25528
Index	100	105	112	118	127	139	150	161	171

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 30. Number of Enrollment Applications and Number of Enrollments in University Engineering Doctorate Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of enrollments a	638	625	635	650	715	832	1089	1062	1244
Index	100	98	102	102	112	130	171	167	195
Number of applicants b	745	723	732	749	784	917	1192	1161	1350
Ratio b/a	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1

Source: Ministry Education, Science,and Culture "Report of Basic Survey on Schools" (each year).

Table 31. Rate of Advancement to University Engineering Doctorate Programs

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Department graduates a	69221	71167	74128	73508	75188	73593	69620	70486	71396	73316	75843	76362
Course masters b	6923	7640	7613	7135	6976	7363	7703	8311	8628	9620	10413	11129
Advancements to doctorate program c	718	653	652	559	565	574	569	609	720	892	874	995
Advancement by department c/a			0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	1.0%	1.3%	1.2%	1.4%
Rate of advancement to master's program c/b	10.4%	8.5%	8.6%	7.8%	8.1%	7.8%	7.4%	7.3%	8.3%	9.3%	8.4%	8.9%

Source: Compiled by author from Ministry Education,Science, and Culture " Report of Basic Survey on Schools" (each year)

Note : The advancement rate by department for year X is calculated from number of advancement to doctor's program in X/(X-2)year department graduates *100.

Table 32. Employment Status of Those Who Complete University Engineering Master's Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Completed program	7135	6976	7363	7703	8311	8628	9620	10413	11129
Number of advancements	559	565	574	569	609	720	892	874	995
Number of unemployed	177	133	127	158	134	170	149	196	178
Number of employed	6294	6207	6580	6909	7531	7666	8487	9195	9824
Employment rate (academic advancements excluded)	95.7%	96.8%	96.9%	96.8%	97.8%	96.9%	97.2%	96.4%	96.9%
Rate of unemployment (academic advancements excluded)	2.7%	2.1%	1.9%	2.2%	1.7%	2.1%	1.7%	2.1%	1.8%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 33. Number of Students Engaged in University Engineering Doctorate Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of active students	2358	2218	2151	2165	2223	2403	2820	3196	3639
Index	100	94	91	92	94	102	120	136	154

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 34. Number of Foreign Students Enrolled in University Science Master's Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
National University		29			89		142	113	150
Public University		3			5		11	10	9
Private University		2			1		3	15	6
Total	14	34	54	74	95	125	156	138	165

Source: Investigated by author with reference to "Foreign Student's Guide to Graduate School Enrollment," The Asia Student Cultural Association, For 1987, however, figures were compiled by the author from " University Data Sources " (reference document 33).

Note : The total number of people for 1980, 1982, 1983 and 1985 were calculated by proportional distribution of approximate values according to period.

Table 35. Number of Foreign Students Enrolled in University Science Doctorate Programs and Percentage of Japanese Among Enrolled Students

Year	1981	1982	1983	1984	1985	1986	1987	1988
Number enrolled in doctorate programs	2471	2403	2366	2485	2472	2524	2678	2829
Number of foreign students	37			72		198	194	304
Number of active Japanese students	2434			2413		2326	2484	2525
Percentage of active Japanese students	98.5%	98.0%	97.6%	97.1%	94.7%	92.2%	92.8%	89.3%

Source: Number of foreign students was compiled by the author with reference to " Foreign Student's Guide to Graduate School Enrollment." For 1987, however, " University Data Sources" (reference document 33) was used. The number of students enrolled in a doctorate programs was compiled by the author from Ministry Education, Science and Culture "Report of Basic Survey on Schools" (each year).

Note : The percentages of active Japanese students in 1979,1980, 1982, 1983 and 1985 were derived on the assumption that they are proportional to the surrounding periods.

Table 36. Number of Foreign Students Enrolled in University Engineering Master's Programs

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
National University		187			505		816	914	921
Public University		0			8		9	19	26
Private University		43			88		130	148	136
Total	106	230	354	478	601	778	955	1081	1083

Source: Compiled by the author with reference to "Foreign Student's Guide to Graduate School Enrollment The Asia Student Cultural Association ". For 1987, however, figures were compiled by author from "University Data Sources"(reference document 33).

Note : The total numbers of people in 1980, 1982, 1983 and 1985 were calculated by proportional distribution of the approximate numbers according to period.

Table 37. Number of Foreign Students Enrolled in University Engineering Doctorate Programs and Percentage of Japanese Among Enrolled Students

Year	1981	1982	1983	1984	1985	1986	1987	1988
Number enrolled in doctorate program	2218	2151	2165	2223	2403	2820	3196	3639
Number of foreign students	194			337		724	1010	1170
Number of active Japanese students	2024			1886		2096	2186	2469
Percentage of active Japanese students	91.3%	89.1%	87.0%	84.8%	79.6%	74.3%	68.4%	67.8%

Source: Number of foreign students was compiled by the author with reference to " Foreign Student's Guide to Graduate School Enrollment." For 1987, however, " University Data Sources " (reference document 33) was used.
The number of students enrolled in a doctorate programs was compiled by the author from the Ministry Education, Scince and Culture " Report of Basic Survey on Schools" (each year).

Note : The percentages of active Japanese students in 1979,1980,1982,1983 and 1985 were derived on the assumption that they are proportional to the surrounding periods.

Table 38. Number of Science Course-work Doctorates Per Unit Population (100,000 people) in Japan

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Japanese population	11706	11790	11873	11954	12031	12105	12167	12226	12278
Number of science course -work doctorate	457	433	429	397	459	497	479	464	
Number of per unit course -work doctorate	0.390	0.367	0.361	0.332	0.382	0.411	0.394	0.380	

Source: The Japanese population is the estimated population for each year by the Bureau of Statistics office of the Prime Minister. For 1980 and 1985, however, the population figures come from the national census.
The numbers of course-work doctorates (fiscal year) were compiled by the author from Table 3.

Note : Unit of Japan population is 10,000 people.

Table 39. Number of Japanese Science Course-Work Doctorates Per Unit Population (100,000 people) in Japan

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Japanese population	11706	11790	11873	11954	12031	12105	12167	12226	12278
Number of science course -work doctorates	457	433	429	397	459	497	479	464	
Percentage of active Japanese students	99	98.5	98	97.6	97.1	94.7	92.2	92.8	89.3
Number of Japanese science course-work doctorate	455	429	423	389	448	483	454	428	
Number of Japanese Science course-work doctorates per unit	0.389	0.364	0.356	0.325	0.372	0.399	0.373	0.350	

Source: The Japanese population is the estimated population for each year by the Bureau of Statistics office of the Prime Minister. For 1980 and 1985, however, the population figures come from the national census. The numbers of course doctorates (fiscal year) were compiled by the author from Table 3.

Note : Unit of Japan population is 10,000 people. The percentage of active Japanese students comes from Table 35. However,1979=99.5%. In computing the number of Japanese course doctorates,since the graduate school program lasts for third years,When the percentage of active Japanese students is assumed to be comprised of all second-year students, since these students become third-year students the next year, the number of Japanese course-work doctorates for the current year was obtained by multiplying the percentage of active students in the previous year by the number of course-work doctorates in the current year.

Table 40. Number of Engineering Course-work Doctorates Per Unit Population (100,000 people) in Japan

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Japanese population	11706	11790	11873	11954	12031	12105	12167	12226	12278
Number of engineering -work doctorates	523	541	506	489	447	480	505	621	
Number of Japanese Science course-work doctorates per unit	0.447	0.459	0.426	0.409	0.372	0.397	0.415	0.508	

Source: The Japanese population is the estimated population for each year by the Bureau of Statistics office of the Prime Minister. For 1980 and 1985, however, the population figures come from the national census. The numbers of course-work doctorates (fiscal year) were compiled by the author from Table 7.

Note : Unit of Japan population is 10,000 people.

Table 41. Number of Japanese Engineering Course-work Doctorates Per Unit Population (100,000 people) in Japan

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Japanese population	11706	11790	11873	11954	12031	12105	12167	12226	12278
Number of engineering course-work doctorates	523	541	506	489	447	480	505	621	
Percentage of active Japanese students	93.5	91.3	89.1	87	84.8	79.6	74.3	68.4	67.8
Number of Japanese engineering course-work doctorates	501	506	462	436	389	407	402	461	
Number of Japanese engineering course-work doctorates per unit	0.428	0.429	0.389	0.365	0.323	0.336	0.330	0.377	

Source: The Japanese population is the estimated population for each year by the Bureau of Statistics office of the Prime Minister. For 1980 and 1985, however, the population figures come from the national census. The numbers of course-work doctorates (fiscal year) were compiled by the author from Table 7.

Note : Unit of Japan population is 10,000 people. The percentage of active Japanese students comes from Table 37. However, 1979=95.7%. In computing The number of Japanese course doctorates, since the graduate school programs lasts for third years,When the percentage of active Japanese students is assumed to be comprised of all second-year students , since these students become third-year students the next year, the number of Japanese course-work doctorates for the current year was obtained by multiplying the percentage of active students in the previous year by the number of course-work doctorates in the current year.

Table 42. Number Who Complete University Science Doctorate Programs and Number Who Obtain Academic Degree

Year	Number of completions	Number of graduates without degrees	Number of degree acquisitions	Percentage of degree acquisition
1980	589	264	325	55.2%
1981	607	307	300	49.4%
1982	569	281	288	50.6%
1983	582	268	314	54.0%
1984	529	250	279	52.7%
1985	610	263	347	56.9%
1986	564	216	348	61.7%
1987	605	208	397	65.6%
1988	589	196	393	66.7%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 43. Number Who Complete University Engineering Doctorate Programs and Number Who Obtain Academic Degree

Year	Number of completions	Number of graduates without degrees	Number of degree acquisitions	Percentage of degree acquisitions
1980	657	288	369	56.2%
1981	685	316	369	53.9%
1982	621	246	375	60.4%
1983	579	212	367	63.4%
1984	563	206	357	63.4%
1985	552	194	358	64.9%
1986	588	182	406	69.0%
1987	638	204	434	68.0%
1988	721	202	519	72.0%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 44. Percentage of Doctor's Degree Acquisition by Japanese Students and by Foreign Students

Year	1985	1986	1987	1988	1989
All students	41.4	43.4			
Foreign students among total	54.4	58.5	79.0	89.0	

Source: For 1985and1986, " Report of Results of Administrative inspection to Policies for Acceptance of Foreign Students and Education of Japanese Boys and Girls Returning to Japan,"Administrative Inspection Bureau, Management and Coordination Agency (March 1988). For 1987 and 1988, " Outline of System in Japan for Foreign Students " by the Foreign Student Section,International Bureau of Science,Ministry of Education,Science and Culture (July 1989).

Table 45. Conditions of the Master's Degree in the United States

— Number of Students by Subject Major, Number of Advancing Students, Number of Employed Students and Employment Rate —

Number of Students by Subject Major

	total population						exclusive of full- time graduate student					
	1980	1981	1982	1983	1984	1985	1980	1981	1982	1983	1984	1985
total,all field	41500	46700	48400	47500	54000	61100	32900	36900	37700	37200	42200	48100
physical sciences	2900	2700	3100	3100	3300	4000	2000	1800	1900	1700	1900	2300
math/statistics	2700	4100	3200	2800	3700	3800	2300	3300	2800	2300	3000	3100
environ science	1500	1700	2000	2000	2000	2700	1100	1400	1700	1600	1400	2100
biology	5700	5500	5700	4900	5600	5300	3600	3800	3100	3200	3800	3300
sub-total	12800	14000	14000	12800	14600	15800	9000	10300	9500	8800	10100	10800
computer science	3700	5000	4700	5900	8000	9700	3200	4600	4200	5400	7500	8700
engineering	11700	13800	13000	13900	17800	19900	10200	11700	11100	11600	14700	16600
sub-total	15400	18800	17700	19800	25800	29600	13400	16300	15300	17000	22200	25300

Number of Advancing Students and Advancement Rate

	full-time graduate students						ratio					
	1980	1981	1982	1983	1984	1985	1980	1981	1982	1983	1984	1985
total,all field	8600	9800	10700	10300	11700	13000	21%	21%	22%	22%	22%	21%
physical sciences	900	900	1200	1400	1400	1700						
math/statistics	400	700	400	500	600	800						
environ science	400	300	200	400	600	600						
biology	2100	1600	2600	1700	1800	2000						
sub-total	3800	3500	4400	4000	4400	5100	30%	25%	31%	31%	30%	32%
computer science	500	400	400	500	500	1000						
engineering	1500	2100	1900	2300	3100	3300						
sub-total	2000	2500	2300	2800	3600	4300	13%	13%	13%	14%	14%	15%

	part time graduate students					
	1980	1981	1982	1983	1984	1985
total,all field	4500	4300	4200	4200	5100	4700
physical sciences	300	300	200	200	300	300
math/statistics	200	400	600	100	400	300
environ science	100	100	100	100	100	200
biology	400	500	300	400	600	500
sub-total	1000	1300	1200	800	1400	1300
computer science	300	500	300	400	600	300
engineering	1300	1000	1400	1400	1800	1700
sub-total	1600	1500	1700	1800	2400	2000

Number of Employed Students and Employment Rate

	number of total employed						total employment ratio					
	1980	1981	1982	1983	1984	1985	1980	1981	1982	1983	1984	1985
total,all field	31100	34100	35900	34400	40900	45600	95%	92%	95%	92%	97%	95%
physical sciences	1900	1600	1800	1600	1700	2200						
math/statistics	2200	3000	2700	2100	2900	2900						
environ science	1000	1200	1600	1500	1300	2000						
biology	3400	3500	2800	2800	3600	3100						
sub-total	8500	9300	8900	8000	9500	10200	94%	90%	94%	91%	94%	94%
computer science	3200	4500	4000	5300	7400	8500						
engineering	9800	11300	10900	11000	14400	16200						
sub-total	13000	15800	14900	16300	21800	24700	97%	97%	97%	96%	98%	98%

Source: NSF "characteristics of recent science /engineering graduates: 1982, 1984, 1986".
Note : Employment ratio = employed/exclusive of fulltimes *100.

Table 46. Number of Science and Engineering Doctorates in the United States

	1980	1981	1982	1983	1984	1985	1986	1987	1988
physical sciences	2521	2627	2694	2802	2845	2916	3090	3212	3320
earth,atmos,marin	628	583	657	637	614	617	589	628	726
math/statistics	744	728	720	701	698	688	729	740	749
biology	3803	3804	3893	3741	3880	3791	3808	3836	4106
sub-total 理学系	7696	7742	7964	7881	8037	8012	8216	8416	8901
computer science	218	232	220	286	295	310	399	450	514
engineering	2479	2528	2646	2781	2913	3166	3376	3712	4190
sub-total 工学系	2697	2760	2866	3067	3208	3476	3775	4162	4704

Source: NSF "early release of summary statistics on science and engineering doctorates 1988".
NSF " science and engineering doctorates: 1980-87".
Note : The data for a given year include , doctorates awarded in the 12-mouth on June 30 of that year.

Table 47. Number of Science and Engineering Doctorates Among U.S. Citizens and non-U.S Citizens with permanent Visas in the United States

Yea	1980	1981	1982	1983	1984	1985	1986	1987	1988
Physical sciences	2035	2103	2110	2184	2190	2178	2147	2227	2231
Earth, atmos, marin	538	488	557	513	499	474	446	450	537
Math/statistics	582	525	499	457	443	418	402	396	384
Biology	3430	3421	3434	3324	3399	3254	3242	3143	3310
Sub-total science	6585	6537	6600	6478	6531	6324	6237	6216	6462
Computer science	169	188	155	207	195	213	249	275	326
Engineering	1554	1471	1465	1482	1513	1594	1726	1913	2144
Sub-total engineering	1723	1659	1620	1689	1708	1807	1975	2188	2470

Source: NSF "early release of summary statistics on science and engineering doctorates 1988".
NSF " science and engineering doctorates: 1980-87".
Note : The data for a given year include, doctorates awarded in the 12-mouth on June 30 of that year.

Table 48. Number of Science Doctorates Per Unit Population (100,000 people) in the United States

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
U.S. population	22776	23014	23252	23480	23700	23928	24162	24393	24633
Number of science doctorates	7696	7742	7964	7881	8037	8012	8216	8416	8901
Number of doctorates per unit sciences	3.379	3.364	3.425	3.356	3.391	3.348	3.400	3.450	3.613

Source: The U.S. population was compiled by the author from the United Nations Monthly Bulletin of Statistics (7, 1989) and the number of doctorates, from NSF.
NSF "early release of summary statistics on science and engineering doctorates 1988".
NSF "science and engineering doctorates:1980-87".
Note : The data for a given year include, doctorates awarded in the 12-mouth on June 30 of that year.

Table 49. Number of Engineering Doctorates Per Unit Population (100,000 people) in the United States

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
U.S. population	22776	23014	23252	23480	23700	23928	24162	24393	24633
Number of engineering doctorates	2697	2760	2866	3067	3208	3476	3775	4162	4704
Number of doctorates per unit Engineering	1.184	1.199	1.233	1.306	1.354	1.453	1.562	1.706	1.910

Source: NSF " early release of summary statistics on science and engineering doctorates 1988 ".
NSF "science and engineering doctorates:1980-87".
Note : The data for a given year include , doctorates awarded in the 12-mouth on June 30 of that year.

Table 50. Number of Science Doctorates Per Unit Population (100,000 people) Among U.S. Citizens and non-U.S. Citizen with permanent Visas in the United States

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
U.S. population	22776	23014	23252	23480	23700	23928	24162	24393	24633
Number of U.S. citizen doctorates (science)	6585	6537	6600	6478	6531	6324	6237	6216	6462
Number of doctorates per unit (science)	2.891	2.840	2.838	2.759	2.756	2.643	2.581	2.548	2.623

Source: NSF " early release of summary statistics on science and engineering doctorates 1988".
NSF " science and engineering doctorates:1980-87".
Note : The data for a given year include , doctorates awarded in the 12-mouth on June 30 of that year.

Table 51. Number of Engineering Doctorates Per Unit Population (100,000 people) Among U.S. Citizens and non-U.S. Citizen with permanent Visas in the United States

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
U.S. population	22776	23014	23252	23480	23700	23928	24162	24393	24633
Number of U.S. citizen doctorates (engineering)	1723	1659	1620	1689	1708	1807	1975	2188	2470
Number of doctorates per unit (engineering)	0.756	0.721	0.697	0.719	0.721	0.755	0.817	0.897	1.003

Source: NSF "early release of summary statistics on science and engineering doctorates 1988".
NSF " science and engineering doctorates:1980-87".
Note : The data for a given year include, doctorates awarded in the 12-mouth on June 30 of that year.

Table 52. Employment Rate of Those Who Complete University Science Doctorate Programs, and received this degrees and those who did not

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of completions and received this degree and those who did not	589	607	569	582	529	610	564	605	589
Number of degree acquisitions	325	300	288	314	279	347	348	397	393
Number of employed	259	227	241	232	248	287	298	283	298
Number of unemployed	309	313	302	297	241	278	241	258	248
Employment rate	44.0%	37.4%	42.4%	39.9%	46.9%	47.0%	52.8%	46.8%	50.6%
Employment rate against degree acquisitions	79.7%	75.7%	83.7%	73.9%	88.9%	82.7%	85.6%	71.3%	75.8%
Rate of unemployment	52.5%	51.6%	53.1%	51.0%	45.6%	45.6%	42.7%	42.6%	42.1%

Source: Compiled by author from Ministry of Education, Science and Culture "Report of Basic Survey on Schools" (each year).

Note : Employment rate against degree acquisitions
= number of employed /number of degree acquisitions *100
Rate of unemployment
= number of unemployed / number of completions and received degrees and those who did not *100

Table 53. Employment Rate of Those Who Complete University Engineering Doctorate Programs, and received this degree and those who not.

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of completions and received this degree and those who did not	657	685	621	579	563	552	588	638	721
Number of degree acquisitions	369	369	375	367	357	358	406	434	519
Number of employed	434	438	420	413	412	411	402	409	492
Number of unemployed	175	159	92	94	139	114	126	131	141
Employment rate	66.1%	63.9%	67.6%	71.3%	73.2%	74.5%	68.4%	64.1%	68.2%
Employment rate against degree acquisitions							99.0%	94.2%	94.8%
Rate of unemployment	26.6%	23.2%	14.8%	16.2%	24.7%	20.7%	21.4%	20.5%	19.6%

Source: Compiled by author from Ministry of Education, Science and Culture "Report of Basic Survey on Schools" (each year).

Note : Employment rate against degree acquisitions
= number of employed /number of degree acquisitions *100
Rate of unemployment
= number of unemployed /number of completions and received degrees and those who did not *100

Table 54. Employment Conditions of University Professors and Scientific Researchers Who Completed University Science Doctorate Programs, and received this degree and those who did not

Year	Number of employed	Number of university professors	Number of Scientific researchers	Percentage of employment as university professors	Percentage of employment as scientific researchers
1980	259	117	54	45.2%	20.8%
1981	227	84	55	37.0%	24.2%
1982	241	82	74	34.0%	30.7%
1983	232	85	53	36.6%	22.8%
1984	248	75	59	30.2%	23.8%
1985	287	79	82	27.5%	28.6%
1986	298	96	78	32.2%	26.2%
1987	283	93	76	32.9%	26.9%
1988	298	100	65	33.6%	21.8%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 55. Employment Conditions of University Professors and Scientific Researchers Who Completed University Engineering Doctorate Programs , and received this degrees and those who did not

Year	Number of employed	Number of university professors	Number of scientific researchers	Percentage of employment as university professors	Percentage of employment as scientific researchers
1980	434	165	63	38.0%	14.5%
1981	438	156	52	35.6%	11.9%
1982	420	165	59	39.3%	14.0%
1983	413	162	49	39.2%	11.9%
1984	412	166	46	40.3%	11.2%
1985	411	143	50	34.8%	12.2%
1986	402	165	32	41.0%	8.0%
1987	409	183	34	44.7%	8.3%
1988	492	204	52	41.5%	10.6%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 56. Compositional Percentage by Academic History of University Science Graduates Employed in Manufacturing

academic history \ year	1970	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Department graduates	2924	2346	1836	2020	1839	2120	2165	2563	2997	3056	2903	3440	3557	3610	3083
	90%	87%	90%	86%	83%	83%	81%	82%	81%	80%	78%	80%	80%	79%	76%
master's programs	278	307	188	307	328	391	438	501	631	668	725	783	823	880	914
	9%	11%	9%	13%	15%	15%	17%	16%	17%	18%	20%	18%	18%	19%	22%
doctor's programs	47	56	24	35	35	46	61	74	71	77	83	98	81	73	71
	1%	2%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Total	3249	2709	2048	2362	2202	2557	2664	3138	3699	3801	3711	4321	4461	4563	4068
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 57. Compositional Percentage by Academic History of University Engineering Graduates Employed in Manufacturing

academic history \ year	1970	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Department graduates	28782	27848	27834	30295	30528	27828	31473	35254	35717	33477	33176	35373	35916	36197	32829
	93%	88%	91%	88%	88%	86%	87%	88%	88%	87%	86%	86%	85%	84%	83%
master's programs	2157	3537	2840	3821	4195	4369	4400	4515	4807	5034	5473	5608	6182	6536	6585
	7%	11%	9%	11%	12%	13%	12%	11%	12%	13%	14%	14%	15%	15%	17%
doctor's programs	145	124	81	156	108	183	174	179	140	155	148	139	151	110	138
	0%	1%	0%	1%	0%	1%	1%	1%	0%	0%	0%	0%	0%	1%	0%
Total	31084	31509	30755	34272	34831	32380	36047	39948	40664	38666	38797	41120	42249	42843	39552
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Table 58. Trend in Number of Scholarship Students of the Japan Scholarship Foundation Among Students Enrolled in University Doctorate Programs

Fiscal year	Number of active students	Number of scholarship students	Percentage
1980	9035	8030	88.9%
1981	9173	7722	84.2%
1982	8907	7480	84.0%
1983	9048	7304	80.7%
1984	9306	7388	79.4%
1985	9378	7360	78.5%
1986	9805	7358	75.0%
1987	9871	7247	73.4%
1988			

Source: Japan Scholarship Foundation, "Annual Report".
Note : Number of students and scholarship students do not include students of medicine, dentistry or pharmacology .

Table 59. Status of Economic Support for Master's and Doctorate Students in the United States

full-time graduate students
type of major support

year	1980		1986	
	number	ratio	number	ratio
total sciences	77704	100%	86666	100%
fellowship and traineeship	12341	16%	12978	15%
research assistantships	22240	29%	27712	32%
teaching assistantships	26950	35%	29389	34%
other types of support	4121	5%	4849	6%
self-support	12052	15%	11738	13%
physical sciences	22254		27074	
fellowship and traineeship	2183		2376	
research assistantships	8258		10847	
teaching assistantships	9894		11329	
other types of support	555		807	
self-support	1364		1715	
environmental sciences	10265		10909	
fellowship and traineeship	1107		989	
research assistantships	3664		3789	
teaching assistantships	2563		2554	
other types of support	725		1076	
self-support	2206		2501	
mathematical sciences	9368		11767	
fellowship and traineeship	891		1007	
research assistantships	773		1017	
teaching assistantships	5373		6897	
other types of support	664		840	
self-support	1667		2006	
biological sciences	35817		36916	
fellowship and traineeship	8160		8606	
research assistantships	9545		12059	
teaching assistantships	9120		8609	
other types of support	2177		2126	
self-support	6815		5516	
total engineering	47839	100%	73429	100%
fellowship and traineeship	4970	11%	6674	9%
research assistantships	14951	31%	22691	31%
teaching assistantships	8654	18%	14082	19%
other types of support	4760	10%	6651	9%
self-support	14504	30%	23331	32%
engineering	41939		59925	
fellowship and traineeship	4603		5781	
research assistantships	13928		20407	
teaching assistantships	7245		10973	
other types of support	4117		5380	
self-support	12046		17384	
computer sciences	5900		13504	
fellowship and traineeship	367		893	
research assistantships	1023		2284	
teaching assistantships	1409		3109	
other types of support	643		1271	
self-support	2458		5947	

Source: NSF "science and engineering doctorates: 1980-87".
Note : Number of students denotes full-time students.

Table 60. Age Composition of National University Professors and of Researchers at National Testing and Research Centers

Age Composition of National University Professors

Age category \ Year	Real numbers								Compositional percentage							
	1965	1970	1975	1980	1985	1986	1987	1988	1965	1970	1975	1980	1985	1986	1987	1988
less than 20 years																
20 up to 24 years	267	266	142	100	67	67	55	65	1%	1%	0%	0%	0%	0%	0%	0%
24-28	1831	2811	2140	1402	1115	1060	1011	1058	6%	7%	5%	3%	2%	2%	2%	2%
28-32	3742	5585	5753	5408	4239	4154	4032	4219	12%	15%	14%	11%	8%	8%	8%	8%
32-36	5539	5757	7886	7849	7002	6707	6583	6687	19%	15%	18%	16%	13%	13%	12%	13%
36-40	4336	5630	5706	8458	8329	8622	8370	7830	14%	15%	13%	17%	16%	16%	16%	15%
40-44	3614	4534	5337	5845	7812	7275	7154	7320	12%	12%	13%	12%	14%	14%	13%	14%
44-48	2409	3856	4708	5216	6145	6739	7330	7666	8%	10%	11%	11%	13%	13%	14%	14%
48-52	2273	2628	4036	5172	5051	5182	5152	5345	7%	7%	9%	11%	10%	10%	10%	10%
52-56	2468	2207	2903	4210	5323	5341	5130	4927	8%	6%	7%	9%	10%	10%	10%	9%
56-60	2193	2403	2098	3161	4114	4300	4569	4899	7%	6%	5%	6%	8%	8%	9%	9%
60-	1645	2332	2337	2183	2833	3088	3233	3235	6%	6%	5%	4%	6%	6%	6%	6%
N.A.	8	22							0%	0%						
Total	30325	38031	43046	49004	52030	52535	52619	53251	100%	100%	100%	100%	100%	100%	100%	100%

Age Composition of Researchers at National Testing and Research Centers

Age category \ Year	Real numbers								Compositional percentage							
	1965	1970	1975	1980	1985	1986	1987	1988	1965	1970	1975	1980	1985	1986	1987	1988
less than 20 years	48	58	32	21	8	13		3	1%	1%	0%	0%	0%	0%	0%	0%
20 up to 24 years	587	395	254	162	105	115	113	89	6%	4%	3%	2%	1%	1%	1%	1%
24-28	962	1053	750	582	570	611	640	626	11%	11%	7%	6%	6%	6%	6%	6%
28-32	1200	1318	1174	1040	916	901	942	985	13%	13%	12%	10%	9%	9%	9%	10%
32-36	1811	1154	1547	1260	1120	1063	1039	1054	20%	11%	15%	12%	11%	11%	11%	11%
36-40	1859	1560	1055	1623	1265	1313	1323	1258	20%	16%	11%	15%	13%	13%	13%	13%
40-44	1090	1832	1303	1049	1556	1369	1253	1236	12%	18%	13%	10%	15%	13%	13%	12%
44-48	586	1179	1652	1167	1089	1285	1468	1523	6%	12%	16%	11%	11%	13%	15%	15%
48-52	467	556	1208	1561	1037	970	930	951	5%	6%	12%	15%	10%	10%	9%	10%
52-56	321	400	582	1234	1319	1190	1092	1014	3%	4%	6%	12%	13%	12%	11%	10%
56-60	195	293	325	565	1116	1221	1216	1188	2%	3%	3%	5%	11%	12%	12%	12%
60-	125	140	194	197	31	13	17	18	1%	1%	2%	2%	0%	0%	0%	0%
N.A.	3	7	2						0%							
Total	9254	9945	10078	10461	10132	10064	10033	9945	100%	100%	100%	100%	100%	100%	100%	100%

Source: National Personnel Authority, "Fact-finding Survey of Pay Rates in government sector " (each year).

Note : National university professors apply to the table on remuneration(-) for educational work; researchers at national testing and research centers apply to the table on remuneration for research work.

N.A.: Not Available

Table 61. Trend in Age Composition of University Department Graduates and of Those Who Complete Graduate School Programs Who are Engaged in Specialized Technological Work (All industries)

Subjects who primarily work — 1000 people

Year / Age category	Trend in age composition								Trend in percentage who complete university or graduate school		
	1982				1987						
	Grand total		Graduates of university or graduate school		Grand total		Graduates of university or graduate school				
	Real number	Compositional percentage	Real number	Compositional percentage	Real number	Compositional percentage	Real number	Compositional percentage	1982	1987	Reissued
15-19	48	1%			50	1%					
20-24	700	15%	179	8%	810	14%	207	7%	26%	26%	26%
25-29	850	18%	440	21%	1055	18%	566	20%		54%	
30-34	829	17%	430	20%	868	15%	492	18%	52%	57%	55%
35-39	552	11%	300	14%	900	15%	466	17%		52%	
40-44	456	9%	236	11%	608	10%	321	11%	52%	53%	52%
45-49	410	9%	205	10%	482	8%	243	9%		50%	
50-54	419	9%	170	8%	413	7%	202	7%	41%	49%	50%
55-59	287	6%	91	4%	365	6%	162	6%	32%	44%	44%
60-64	116	2%	34	2%	195	3%	67	2%	29%	34%	34%
65-	155	3%	52	2%	184	3%	70	3%	34%	38%	38%
Grand total	4822	100%	2137	100%	5930	100%	2796	100%	44%	47%	47%

Source: Bureau of Statistics office of the Prime Minister "1982 Employment Status Survey" Statistics Bureau Management and coordination Agency "1987 Employment Status Survey".

Table 62. Trend in Age Composition of University Department Graduates and of 1Those Who Complete Graduate School Programs Who are Engaged in Manufacturing

Subjects who primarily work — 1000 people

Year / Age category	Trend in age composition									Trend in percentage who complete university or graduate shcool		
	1982				1987							
	Grand total		Graduates of university or graduate school		Grand total		Graduates of university or graduate school					
	Real number	Compositional percentage	Real number	Compositional percentage	Real number	Cpomposi-tional percentage	Real number	Compositional percentage	Reissued	1982	2987	Reissued
15-19					427	3%		0%				
20-24	1612	13%	134	9%	1449	12%	142	8%	8%	8%	10%	8%
25-29					1225	10%	343	20%			28%	
30-34	2903	24%	566	40%	1174	9%	271	16%	36%	19%	23%	26%
35-39					1728	14%	286	17%			17%	
40-44	3309	27%	430	30%	1661	13%	214	13%	30%	13%	13%	15%
45-49					1697	13%	179	11%			11%	
50-54	2776	23%	225	16%	1481	12%	136	8%	19%	8%	9%	10%
55-59	784	7%	41	3%	956	8%	74	4%	4%	5%	8%	8%
60-64	352	3%	18	1%	425	3%	28	2%	2%	5%	7%	7%
65-	346	3%	19	1%	342	3%	22	1%	1%	5%	6%	6%
Grand total	12082	100%	1433	100%	12565	100%	1695	100%	100%	12%	13%	13%

Source: Bureau of Statistics office of the Prime minister "1982 Employment Status Survey" Statistics Bureau Management and coordination Agency "1987 Employment Status Survey".

Table 63. Compositional Percentage by Academic History of University Science Graduates Employed as University Professors or Scientific Researchers

Academic history	Category \ Year	1970	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Department gradiates	University professors	54	43	76	29	41	20	23	28	38	14	11	10	4	25	13
	Scientific researchers	369	290	330	207	278	362	325	253	189	301	208	71	97	245	174
	Total	423	333	406	236	319	382	348	281	227	315	219	81	101	270	187
	Index	127	100	122	71	96	115	105	84	68	95	66	24	30	81	46
	Compositional percentage	57%	55%	66%	48%	59%	58%	52%	47%	42%	54%	44%	18%	23%	45%	33%
Master's programs	University professors	109	58	48	44	47	37	40	35	24	26	17	22	22	15	20
	Scientific researchers	50	63	41	70	64	87	117	145	143	110	125	174	138	151	190
	Total	159	121	89	114	111	124	157	180	167	136	142	196	160	166	210
	Index	131	100	74	94	92	102	130	149	138	112	117	162	132	137	174
	Compositional percentage	21%	20%	15%	23%	21%	19%	23%	30%	30%	23%	29%	45%	37%	27%	38%
Doctorates programs	University professors	143	117	97	113	80	111	117	84	82	85	75	79	96	93	100
	Scientific researchers	22	37	21	28	28	37	54	55	74	53	59	82	78	76	65
	Total	165	154	118	141	108	148	171	139	156	138	134	161	174	169	165
	Index	107	100	77	92	70	96	111	90	101	90	87	105	113	110	107
	Compositional percentage	22%	25%	19%	29%	20%	23%	25%	23%	28%	23%	27%	37%	40%	28%	29%
Total	University professors	306	218	221	186	168	168	180	147	144	125	103	111	122	133	133
	Scientific researchers	441	390	392	305	370	486	496	453	406	464	392	327	313	472	429
	Total	747	608	613	491	538	654	676	600	550	589	495	438	435	605	562
	Index	123	100	101	81	88	108	111	99	90	97	81	72	72	100	92
	Compositional percentage	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Note : The index is 1975=100.

Table 64. Compositional Percentage by Academic History of University Engineering Graduates Employed as University Professors or Scientific Researchers

Academic history	Category \ Year	1970	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Department graduates	University professors	139	86	90	41	38	32	49	88	43	57	20	70	29	10	32
	Scientific researchers	264	244	327	296	236	291	131	142	134	271	76	61	33	58	760
	Total	403	330	417	337	274	323	180	230	177	328	96	131	62	68	792
	Index	122	100	126	102	83	98	55	70	54	99	29	40	19	21	240
	Compositional percentage	47%	48%	48%	36%	29%	33%	21%	23%	20%	36%	13%	27%	14%	14%	58%
Course masters	University professors	160	137	128	138	129	98	98	88	82	78	76	69	82	77	77
	Scientific researchers	38	60	132	235	344	366	370	453	390	299	328	98	112	134	235
	Total	198	197	260	373	473	464	468	541	472	377	404	167	194	211	312
	Index	101	100	132	189	240	236	238	275	240	191	205	85	98	107	158
	Compositional percentage	23%	28%	30%	40%	50%	48%	53%	56%	54%	41%	57%	34%	43%	43%	23%
Course doctorates	University professors	237	137	168	166	152	156	165	156	165	162	166	143	165	183	204
	Scientific researchers	18	32	28	55	41	28	63	52	59	49	46	50	32	34	52
	Total	255	169	196	221	193	184	228	208	224	211	212	193	197	217	256
	Index	151	100	116	131	114	109	135	123	133	125	125	114	117	128	151
	Compositional percentage	30%	24%	22%	24%	21%	19%	26%	21%	26%	23%	30%	39%	43%	44%	19%
Total	University professors	536	360	386	345	319	286	312	332	290	297	262	282	276	270	313
	Scientific researchers	320	336	487	586	621	685	564	647	583	619	450	209	177	226	1047
	Total	856	696	873	931	940	971	876	979	873	916	712	491	453	496	1360
	Index	123	100	125	134	135	140	126	141	125	132	102	71	65	71	195
	Compositional percentage	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Ministry Education, Science, and Culture "Report of Basic Survey on Schools" (each year).

Note : The index is 1975=100.

Table 65. Number of Graduates from Engineering or Science Departments, Number Who Complete Master's Programs, and Number of Doctorates:Japan vs the United States

Year	Type of degree		Japan			United States	
			Science	Engineering		Science	Engineering
1980	Total population			11706			22776
	Doctorates	Number of course doctorates	469	545		7696	2697
		Number of foreign students	2				
		Number after subtracting foreign students	467	545			
		Number of young dissertation doctorates	159	189			
		Japanese doctorates	626	734	U.S. citizen doctorates	6585	1723
		Per unit	0.53	0.63		2.89	0.76
	Master's	Number of completions	1649	7135		12800	15400
		Number of advancing students	632	559			
		Number of foreign students					
		Number of students in industry	1017	6576		7924	10057
		Per unit	0.87	5.62		3.48	4.42
	Bachelors	Number of graduates	11554	73508		76300	71000
		Number of advancing students	1941	7213			
		Number of foreign students	11	99			
		Number of students in industry	9602	66196		49450	61936
		Per unit	8.20	56.55		21.71	27.19
1985	Total population			12105			23928
	Doctorates	Number of course doctorates	459	447		8012	3476
		Number of foreign students	11	68			
		Number after subtracting foreign students	448	379			
		Number of young dissertation doctorates	136	211			
		Japanese doctorates	584	590	U.S. citizen doctorates	6324	1807
		Per unit	0.48	0.49		2.64	0.76
		Number of completions	1992	8628		15800	29600
		Number of advancing students	612	720			
		Number of foreign students	48	301			
		Number of students in industry	1332	7607		9286	18904
		Per unit	1.10	6.28		3.88	7.90
		Number of graduates	12698	71396		75300	124700
		Number of advancing students	2445	9905			
		Number of foreign students	8	208			
		Number of students in industry	10245	61283		48456	105462
		Per unit	8.46	50.63		20.25	44.07
1988	Total population			12278			24633
	Doctorates	Number of course doctorates	464	621		8901	4704
		Number of foreign students	36	160			
		Number after subtracting foreign students	428	461			
		Number of young dissertation doctorates	127	222			
		Japanese doctorates	555	683	U.S. citizen doctorates	6462	2470
		Per unit	0.45	0.56		2.62	1.00
	Master's	Number of completions	2377	11129			
		Number of advancing students	752	995			
		Number of foreign students	69	540			
		Number of students in industry	1556	9594			
		Per unit	1.27	7.81			
	Bachelors	Number of graduates	13388	76362			
		Number of advancing students	3007	12314			
		Number of foreign students	21	404			
		Number of students in industry	10360	63644			
		Per unit	8.44	51.84			

Note: The number of doctorates in Japan means fiscal 1979 for 1980, fiscal 1984 for 1985 and fiscal 1987 for 1988.
The Numbers of course-work doctorates come from Tables 3 and 7 of attached statistics tables.
The number of young doctorates comes from Table 70 of the tables.
The number of U.S.citizen doctorates includes U.S. citizens and non-U.S.citizens with perma nent visas.
The number of foreign students is obtained by dividing the number of foreign students given in the Report of Basic Survey on Schools by 4 , the number of active student years.
The number of master's degree foreign students is obtained by dividing.
The number of foreign students given in Tables 34 and 36 of the attached tables by 2, the number of active student years.
The number of foreign students among the number of course-work doctorates comes from Table 16 and 33 of the Report.

Attached Table Computation Table of Human Resources Supply in Science and Engineering in the United States

bachelor's, master's, doctor's in the United States

	1980								1985							
	number	u.s citizens 1979	u.s citizens 1981	u.s citizens 平均	u.s citizens	full time	u.s full time	u.s citizens	number	u.s citizens	u.s citizens	u.s citizens 1985	u.s citizens	full time	u.s full time	u.s citizens
bachelor's																
physical sciences	16500	97	96.9	97	15997	6900	6690	9307	17000			97	16490	6900	6693	9797
math/statistics	12100	96.9	95.9	96	11664	1300	1253	10411	16600			95	15770	2500	2375	13395
environ science	6800	97	96.1	97	6565	1800	1738	4827	7500			96	7200	1600	1536	5664
biorogy	40900	98.2	97.9	98	40102	15500	15198	24904	34200			98	33516	14200	13916	19600
sub total	76300				74329	25500	24879	49450	75300				72976	25200	24520	48456
computer science	10500	95.7	94.8	95	10001	200	191	9810	40000			95	38000	2200	2090	35910
engineering	60500	92.3	90.6	91	55327	3500	3201	52126	84700			92	77924	9100	8372	69552
sub total	71000				65328	3700	3392	61936	124700				115924	11300	10462	105462
master's degree																
physical sciences	2900	86.9	85	86	2493	900	774	1719	4000			95	3800	1700	1615	2185
math/statistics	2700	84.4	81.9	83	2245	400	333	1912	3800			77	2926	800	616	2310
environ science	1500	85.5	83.4	84	1267	400	338	979	2700			82	2214	600	492	1722
biorogy	5700	93.2	93.8	94	5330	2100	1964	3366	5300			93	4929	2000	1860	3069
sub total	12800				11333	3800	3409	7924	15800				13869	5100	4583	9286
computer science	3700	84.4	78.2	81	3008	500	407	2601	9700			78	7566	1000	780	6786
engineering	11700	74.1	72.1	73	8553	1500	1097	7456	19900			73	14527	3300	2409	12118
sub total	15400				11561	2000	1504	10057	29600				22093	4300	3189	18904
doctorates				u.s citizens	permanent visas	total					u.s citizens	permanent visas	total			
physical sciences				1884	151	2035					2043	135	2178			
earth,atmos,&marine	sci			512	26	538					442	32	474			
mathematics				520	62	582					376	42	418			
biorogy				3279	151	3430					3144	108	3252			
sub total				6195	390	6585					6005	317	6322			
computer science				156	13	169					189	24	213			
engineering				1255	299	1554					1279	315	1594			
sub total				1411	312	1723					1468	339	1807			

Source: NSF ôcharacteristics of recent science & engineering graduates: 1982,1984,1988 û

Note : U.S. citizens with bachelor's and master's degrees are calculated by the following formula:
(number * percentage of U.S. citizens)
-(number of full-time * percentage of U.S. citizens)

Table 66. Total Number of Science Doctorates Per Unit Population(100,000 people) in Japan (Total of course-work doctorates and dissertation doctorates)

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Japanese population	11706	11790	11873	11954	12031	12105	12167	12226	12278
Number of science course -work doctorates	457	433	429	397	459	497	479	464	
Number of science dissertation doctorates	365	358	333	377	348	363	341	373	
Total	822	791	762	774	807	860	820	837	
Number of doctorates per unit	0.702	0.671	0.642	0.647	0.671	0.710	0.674	0.685	

Source: The Japanese population is the estimated population for each year by the Bureau of Statistics of the Office Prime Minister.The figures for 1980 and 1985, however,come from the national census. The number of course-work doctorates and number of dissertation doctorates (fiscal year) were compiled by the author from Table 3.

Note : The unit of the Japanese population is 10,000 people.

Table 67. Total Number of Engineering Doctorates Per Unit Population (100,000 people) in Japan (Total of course-work doctorates and dissertation doctorates)

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Japanese population	11706	11790	11873	11954	12031	12105	12167	12226	12278
Number of engineering course doctorates	523	541	506	489	447	480	505	621	
Number of engineering dissertation doctorates	663	695	772	801	844	924	988	926	
Total	1186	1236	1278	1290	1291	1404	1493	1547	
Number of doctorates per unit	1.013	1.048	1.076	1.079	1.073	1.160	1.227	1.265	

Source: The Japanese population is the estimated population for each year by the Bureau of Statistics of the Office Prime Minister.The figures for 1980 and 1985, however,come from the national census.The number of course-work doctorates and number of dissertation doctorates (fiscal year) were compiled by the author from Table 7.

Note : The unit of the Japanese population is 10,000 people.

Table 68. Total Number of Japanese Science Doctorates Per Unit Population (100,000 people)in Japan (Total of Japanese course-work doctorates and dissertation doctorates)

Year	1980	1981	1982	1983	1984	1985	1986	1987
Japanese population	11706	11790	11873	11954	12031	12105	12167	12226
Number of Japanese science students								
Number of course doctorates	455	429	423	389	448	483	454	428
Number of dissertation doctorates	365	358	333	377	348	363	341	373
Total	820	787	756	766	796	846	795	801
Number of doctorates per unit	0.700	0.668	0.637	0.641	0.662	0.699	0.653	0.655

Source: The Japanese population is the estimated population for each year by the Bureau of Statistics of the Office Prime Minister.The figures for 1980 and 1985, however, come from the national census. The number of course-work doctorates and number of dissertation doctorates (fiscal year) were compiled by the author from Table 3.

Note : The unit of the Japanese population is 10,000 people.

Table 69. Total Number of Japanese Engineering Doctorates Per Unit Population (100,000 people) in Japan (Total of Japanese course-work doctorates and dissertation doctorates)

Year	1980	1981	1982	1983	1984	1985	1986	1987
Japanese population	11706	11790	11873	11954	12031	12105	12167	12226
Number of Japanese engineering students								
Number of course doctorates	501	506	462	436	389	407	402	461
Number of dissertation doctorates	663	695	772	801	844	924	988	926
Total	1164	1201	1234	1237	1233	1331	1390	1387
Number of doctorates per unit	0.994	1.019	1.039	1.035	1.025	1.100	1.142	1.134

Source: The Japanese population is the estimated population for each year by the Bureau of Statistics of the Office Prime Minister.The figures for 1980 and 1985, however,come from the national census.The number of course-work doctorates and number of dissertation doctorates (fiscal year) were compiled by the author from Table 7.

Note : The unit of the Japanese population is 10,000 people.

Table 70. Number of Young Doctorates Per Unit Population

Fiscal year	Science									
	1979		1980		1984		1985		1987	
Japanese population	11616		11706		12031		12105		12226	
	total number	Japanese	total number	Japanese	total number	Japanese	total number	Japanese	total number	Japanese
Number of course doctorates (a)	469	467	457	455	459	448	497	483	464	428
Number of dissertation doctorates (b)	345	345	365	365	348	348	363	363	373	373
Percentage of young dissertation doctorates (c)	0.46	0.46	0.45	0.45	0.39	0.39	0.37	0.37	0.34	0.34
Number of young dissertation doctorates (bxc)=d	159	159	164	164	136	136	134	134	127	127
Number of young doctorates (a+d)	628	626	621	619	595	584	631	617	591	555
Number of doctorates per unit	0.54	0.54	0.53	0.53	0.49	0.49	0.52	0.51	0.48	0.45

Fiscal year	Engineering									
	1979		1980		1984		1985		1987	
Japanese population	11616		11706		12031		12105		12226	
	total number	Japanese	total number	Japanese	total number	Japanese	total number	Japanese	total number	Japanese
Number of course doctorates (a)	545	545	523	501	447	379	480	407	621	461
Number of dissertation doctorates (b)	650	650	663	663	844	844	924	924	926	926
Percentage of young dissertation doctorates (c)	0.29	0.29	0.28	0.28	0.25	0.25	0.25	0.25	0.24	0.24
Number of young dissertation doctorates (bxc)=d	189	189	186	186	211	211	231	231	222	222
Number of young doctorates (a+b)	734	734	709	687	658	590	711	638	843	683
Number of doctorates per unit	0.63	0.63	0.61	0.59	0.55	0.49	0.59	0.53	0.69	0.56

Note 1: Japanese Population is for year in unit of 10,000 people.
Number of doctorates is for fiscal year.

Note 2: It is assumed that foreign students are not included among dissertation doctorates. For the percentage of young dissertation doctorates (up to 35 years old), see Table 7. However, since 1970 =59% and 1988=33% for science; and 1970=34% and 1988=23% for engineering, the percentages for 1979, 1980, 1984, 1985 and 1987 were computed from the percentages for 1970 and 1988 by proportional distribution of the time period.

Fiscal year	science	engineering
1979	$59 - \frac{59-33}{18} \times 9$	$34 - \frac{34-23}{18} \times 9$
1980	$59 - \frac{59-33}{18} \times 10$	$34 - \frac{34-23}{18} \times 10$
1984	$59 - \frac{59-33}{18} \times 14$	$34 - \frac{34-23}{18} \times 14$
1985	$59 - \frac{59-33}{18} \times 15$	$34 - \frac{34-23}{18} \times 15$
1987	$59 - \frac{59-33}{18} \times 17$	$34 - \frac{34-23}{18} \times 17$

Table 71. Conditions at Universities and Graduate Schools in 1989

	Science			Engineering		
	Bachelor's	Master's	Doctor's	Bachelor's	Master's	Doctor's
Enrollment applicants		5975	1014		18571	1384
To national universities		4431	853		13668	1178
Enrollment		3125	929		13459	1258
To national universities		2217	788		9573	1070
Prescribed enrollments		3224	1300		10173	2560
To national universities		2193	812		6951	1743
Sufficiency rate		0.97	0.71		1.32	0.49
For national universities		1.01	0.97		1.38	0.61
Number of graduates	13295	2598	675	75678	11915	915
Number of advancing students	3135	802		12514	983	
(advancement rate)	24	31		17	8	
Number of employed graduates	9258	1626	328	61226	10629	624
(employment rate)	70	63	49	81	89	68
Employment in manufacturing	2955	1107	83	31846	7260	207
(percentage)	32	68	25	52	68	33
Employment as scientific researchers		204	110		225	96
(percentage)		13	34		3	15
Number of unemployed		107	256		138	194
(rate of unemployment)		4	38		1	21

Source: Ministry Education, Science, and Culture, "Immediate Values Report of Basic Survey on Schools". Ministry Education, Science, and Culture, "List of Universities Nationwide (FY 1989)".

Note : Doctor's Number of those who complete doctor's programs and received this degrees and those who did not. Prescribed enrollments was compiled by the author from the "List of Universities Nationwide" based on the "Subject System Classification Table " of the " Report of Basic Survey on schools. " The rate of academic advancement, rate of employment and rate of unemployment are all rates against number of graduates. The percentages of employment in manufacturing and as scientific researchers are percentages against number of employed graduates.

Ⅶ Postcript

VII Postscript

This investigative survey was undertaken as part of the "Survey of Conditions for Securing Creative Human Resources in Science and Technology from Science Students," which was conducted from fiscal 1988 by the No. 1 Investigative Research Group.

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